MEDICAL INSTRUMENTS

AVL 9120, 9130, 9140, 9180, 9181 Electrolyte Analyzers

Service Manual

Tenth Edition
November 1997

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Important Information!

This Operator´s Manual contains important warnings and safety information to be observed by the user.

This instrument is only intended for one area of application which is described in the instructions. The most important prerequisites for application, operation and safety, are explained to ensure smooth operation. No warranty or liability claims will be covered if the instrument is applied in areas other than those described or if the necessary prerequisites and safety measures are not observed.

The instrument is only to be operated by qualified personnel capable of observing these prerequisites.

Only accessories and supplies either delivered by or approved by AVL are to be used with the instrument.

Due to the operating principle of the instrument, analytical accuracy not only depends on correct operation and function, but also upon a variety of external influences beyond the manufacturers control. Therefore, the test results from this instrument must be carefully examined by an expert, before further measures are taken based on the analytical results.

Instrument adjustment and maintenance with removed covers and connected power mains are only to be performed by a qualified technician who is aware of the dangers involved.

Instrument repairs are only to be performed by the manufacturer or qualified service personnel.

Symbol	Explanation
	Attention symbol - Refer to the Operator's Manual or Service Manual for further instructions. This symbol is located on the inside of the instrument.
	Type B instrument symbol - An instrument of the B type falls under safety categories I, II, or III, or has an internal power supply providing the required insulation against discharge current and reliable ground connections.

Important Information!

Operating Safety Information

- This instrument falls under Safety Category I.
- This instrument is a Class B instrument.

This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) this device may not cause harmful interference's, and (2) this device must accept any interference received, including interference that may cause undesired operation.

Warning: Changes or modifications to this unit not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

Note: This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation.
This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communication. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does not cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna
- Increase the separation between the equipment and receiver
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio TV technician for help

Caution:

- The instrument is designed as a conventional device (closed, not waterproof type).
- Do not operate the instrument in an explosive environment or in the vicinity of explosive anesthetic mixtures containing oxygen or nitrous oxide.
- This instrument is suitable for continuous operation.
- The power plug is to be plugged into a ground socket only. When using an extension cord, make sure that it is of the proper size and is properly grounded.
- Any breakage of the ground lead inside or outside the instrument or a loose ground connection can cause a hazardous condition when operating the instrument. Intentional disconnection of the grounding is not permitted.
- When replacing the fuses, make sure that they are of the same type and rating as the original fuses. Never use repaired fuses or short-circuit the fuse holders.

Operating Safety Information

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1 Introduction

The Service Manual for the 9120, 30, 40, 80, and 81 Electrolyte Analyzers contains the technical information needed to ensure easy fault identification. This manual is intended to be complementary to the Operator's Manual where detailed instructions for operation, maintenance and troubleshooting are provided.

As for all clinical instrumentation, a thorough understanding of the principles of operation is prerequisite to attempting service of this product. Training along with experience will enhance the use of this manual.

Service and repair of 9120, 30, 40, 80, and 81 analyzers should be performed only by qualified repair technicians. Care should be taken when removing the covers as hazardous voltages are exposed. Use only accepted electronic test procedures and static protection when replacing and handling all electronic parts.

This manual is divided into 9 chapters to facilitate location of technical information. Chapter 2 provides specifications and operating parameter information. Chapter 3 includes flow charts for all system functions and detailed operation of system test procedures. In Chapter 4, all mechanical, fluidic and electronic assemblies are described. Chapter 5 outlines routine maintenance and troubleshooting procedures. Chapter 6 includes electronic adjustments and Chapter 7 provides the system block diagram and all circuit schematic diagrams and wiring interconnection information. In Chapter 8, part identification, location and description is provided by the illustrated parts list. Finally, in Chapter 9 interface specifications are provided for the RS232 output.

2 General Description

Specifications

2.1 Reported Parameters

		Measuring Range	Resolution
Whole Blood Serum Plasma			
Sodium	Na^+	40 - 205 mmol/L	0.1 mmol/L
Potassium	K^+	1.5 - 15 mmol/L (0.8 - 15 mmol/L dialysate)	0.01 mmol/L
Chloride	Cl^-	50 - 200 mmol/L	0.1 mmol/L
Calcium	Ca^{++}	0.2 - 5.0 mmol/L	0.01 mmol/L
Lithium	Li^+	0.1 - 6.0 mmol/L	0.001 mmol/L
Urine			
Sodium	Na^+	1 - 300 mmol/L	1.0 mmol/L
Potassium	K^+	4.5 - 120 mmol/L (60 - 120 mmol/L w. addit. dilution)	0.1 mmol/L
Chloride	Cl^-	1 - 300 mmol/L	1.0 mmol/L

Calcium and Lithium are not measured in urine samples.
Lithium is not measured in dialysate samples.

2.2 Operating Parameters

Sample type	Whole blood, serum, plasma, urine, dialysate (acetate or bicarbonate)
Sample device	Syringe, sample cup, collection tube, capillary
Sample size	95 µL
Analysis time	50 seconds
Sample rate	45 per hour with printout 60 per hour without printout

Measurement

Sodium (Na^+) sensor	Ion-selective, flow-through, glass capillary electrode
Potassium (K^+) sensor	Ion-selective, flow-through, liquid membrane electrode
Chloride (Cl^-) sensor	Ion-selective, flow-through, liquid membrane electrode
Calcium (Ca^{++}) sensor	Ion-selective, flow-through, liquid membrane electrode
Lithium (Li^+) sensor	Ion-selective, flow-through, liquid membrane electrode
Reference System	Open liquid junction, flow-through electrode
Calibration	Fully automatic 1 point with each sample 2 point every 3 hours (9180/9181 every 4 hrs.)
Standby Mode	suspends calibrations
Warm-up time	1 minute
Temperature	Room temperature, 15 - 32° C, 60 - 90° F
Humidity	maximum 85% relative humidity, non-condensing
Data management	Quality Control memory storage, 3 levels, 35 values; calculation of mean, standard deviation, and coefficient of variation (CV)
Diagnostic Programs	user-controlled diagnostics, YES/NO operation via the display
Electronics	Microprocessor-controlled
Display	LCD dot-matrix, 2 line, 16 characters per line
Printer	Integral thermal printer, 16 character width
Autosampler (9181 only)	Integral turntable - 18 positions, 2 mL or 0.25 mL sample cups

Interface	RS232C Serial Port
Data Link	Data link to Compact 2/3 (9180/9181)
Electrical requirements	100 - 240 V~, 50/60 Hz, 1.4 A max. Self-adjusting
Nominal power consumption	30 W

Dimensions

height	12.2"; 335mm
width	12.4"; 315m
depth	12.0"; 295mm
weight	approx. 13 lbs; 6kg

Classifications

Safety category	I
Device type	B (according to ÖVE-MG/EN 60601-1, IEC 601-1)
Mode of operation	continuous operation
Protection classification	IP 20
Explosion protection	the device is not designed for operation in explosive environments.
Approvals	CSA, CE, FCC Class B CLIA Complexity Category: Moderate Test System Code: 04739 FDA 510(k) number: K972673
Analyte Codes:	Na^+: 5805 K^+: 4910 Cl^-: 1018 iCa^{++}: 1004 Li^+: 3712

Data subject to change without notice. Technical information is supplied for general informational purposes only.

3 Software Operation

3.1 Software Operation - 9120, 9130, 9140

Software operation of the 9120, 9130, 9140 analyzers can be accessed by **YES/ NO** selection on the analyzer front panel. The following flow chart diagrams are provided to identify operating sequences of the 9120, 9130, 9140 Analyzers:

1. Overall Program Operating Flow
2. Main Menu
3. Measurement Sequence
4. Print Functions Menu
5. QC/Standard/Urine Sample Menu
6. Daily Maintenance Menu
7. Operator Functions Menu
8. Program Instrument Menu
9. Service Functions Menu
10. Calibration Sequence

3.2 Software Operation - 9180

1. Overall Program Operating Flow
2. Main Menu
3. Measurement Sequence
4. Print Functions Menu
5. QC/Std/Dialysate/Urine Sample Menu
6. Daily Maintenance Menu
7. Operator Functions Menu
8. Program Instrument Menu
9. Service Functions Menu
10. Calibration Sequence
11. Power-up Sequence

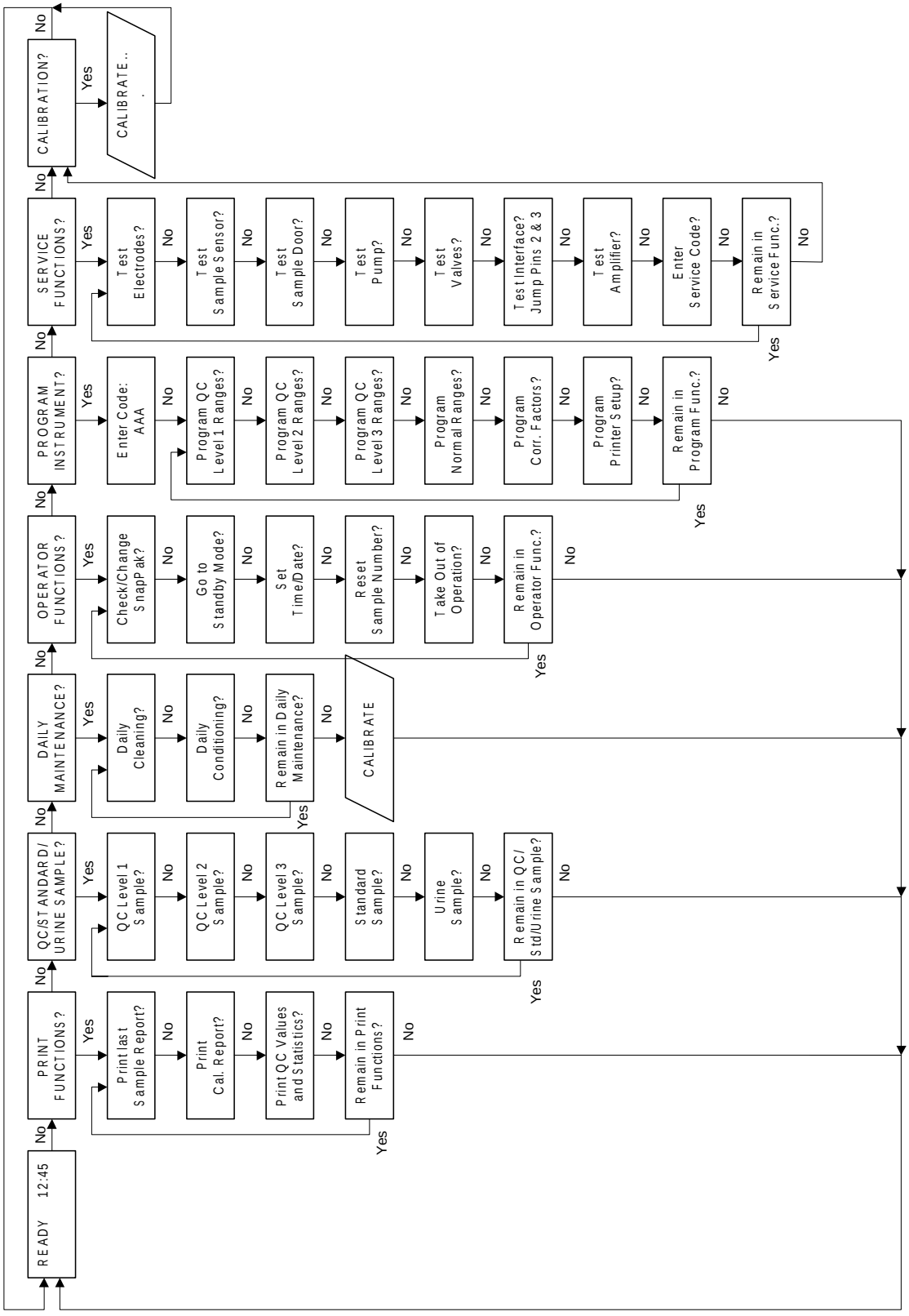
3.3 Software Operation - 9181

1. Overall Program Operating Flow
2. Main Menu
3. Measurement Sequence
4. Print Functions Menu
5. QC/Std/Dialysate/Urine Sample Menu
6. Daily Maintenance Menu
7. Operator Functions Menu
8. Program Instrument Menu
9. Service Functions Menu
10. Calibration Sequence
11. Power-up Sequence

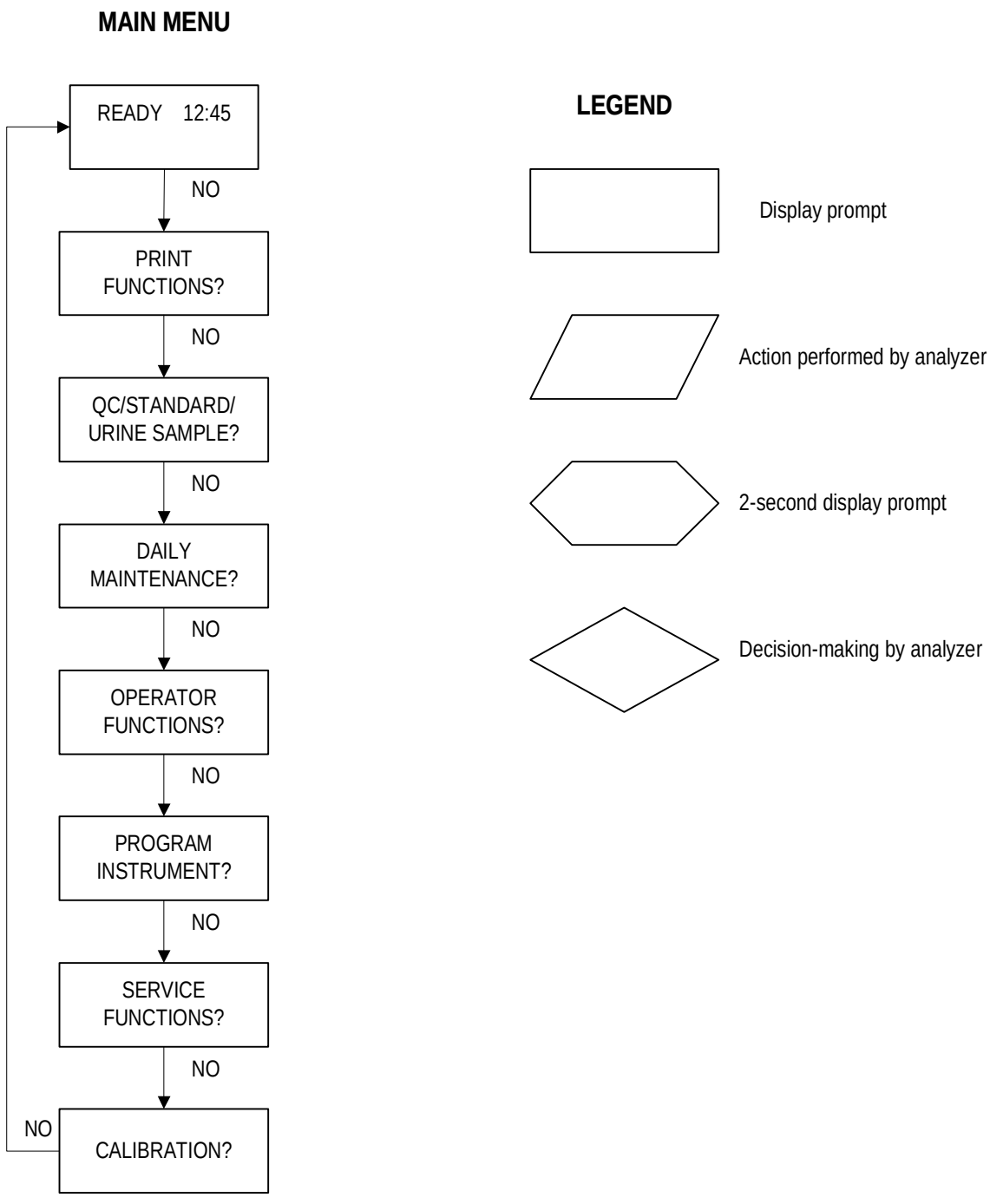
The Service Functions Menu is also provided with a more detailed description of each test parameter for use in testing instrument subassemblies.

3.1 Software Operation - 9120, 30, 40

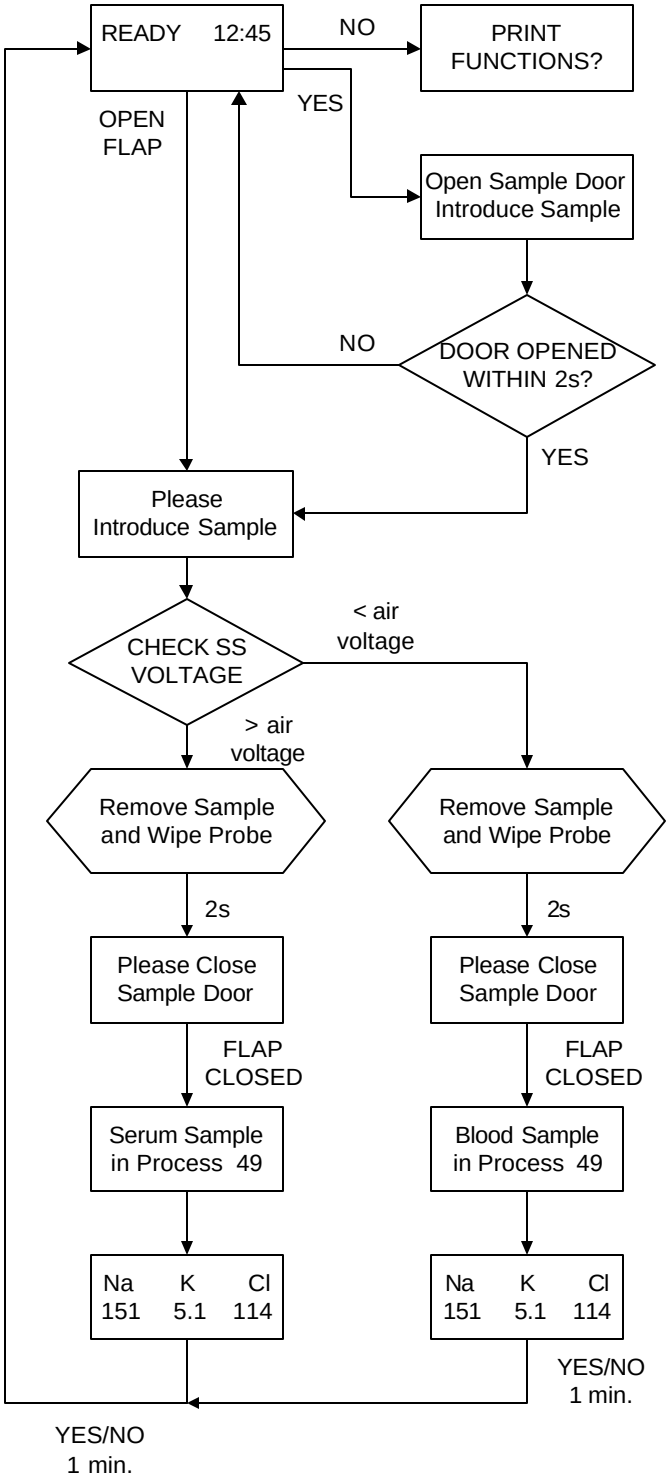
1 Overall Program Operating Flow - 9120, 30, 40



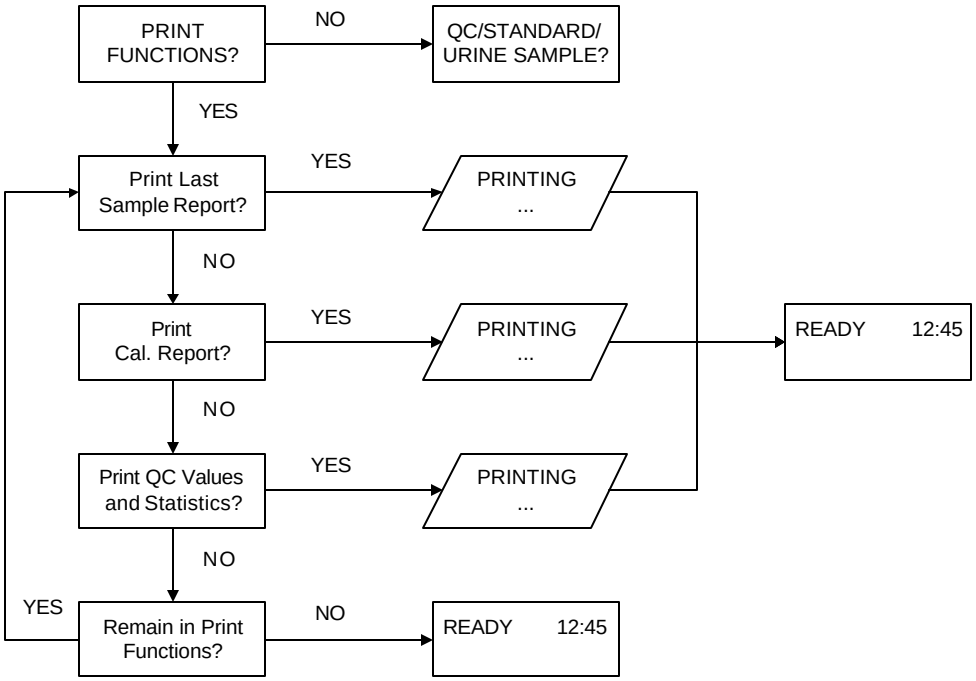
2 Main Menu - 9120, 30, 40



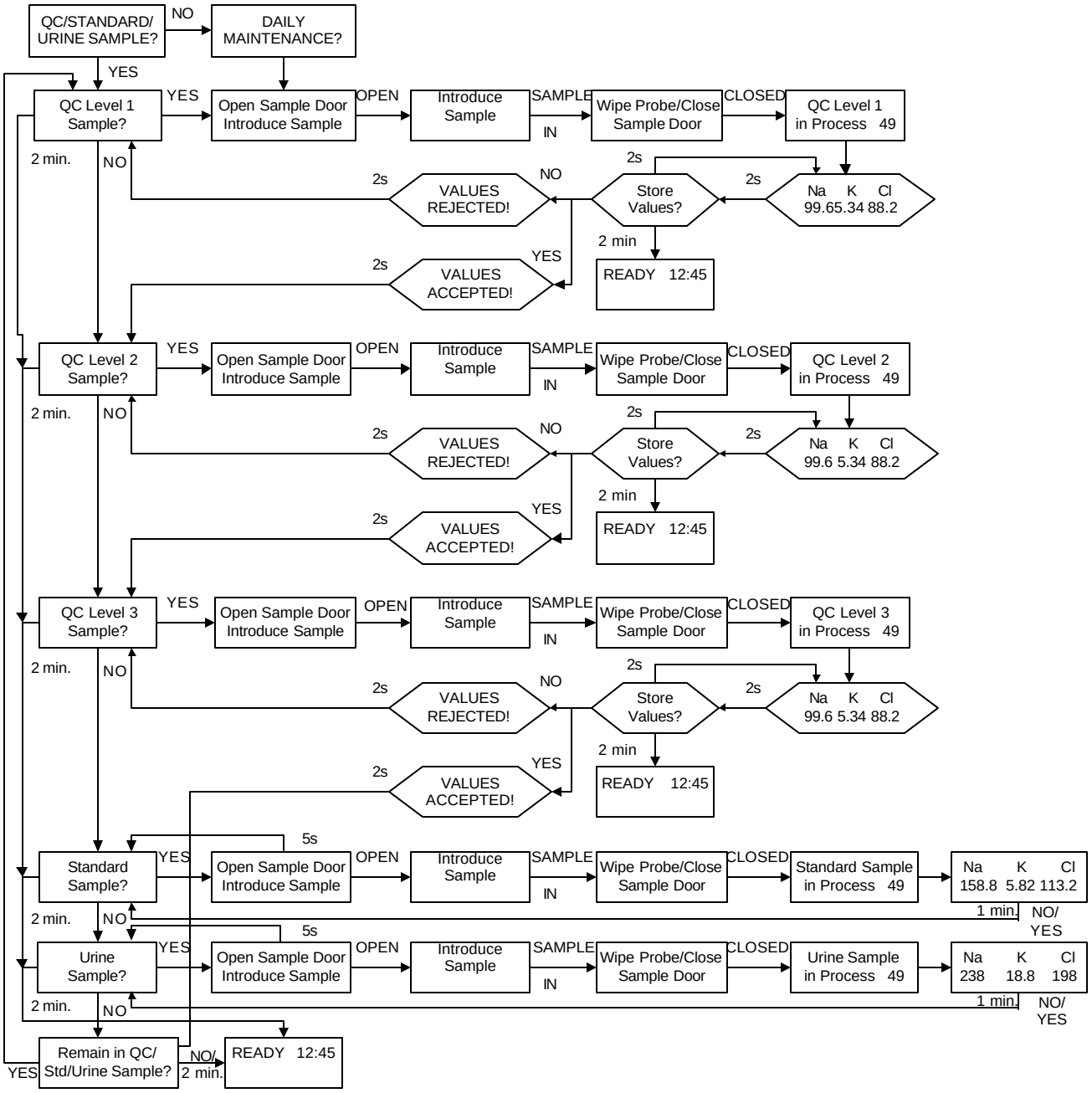
3 Measurement Sequence - 9120, 30, 40



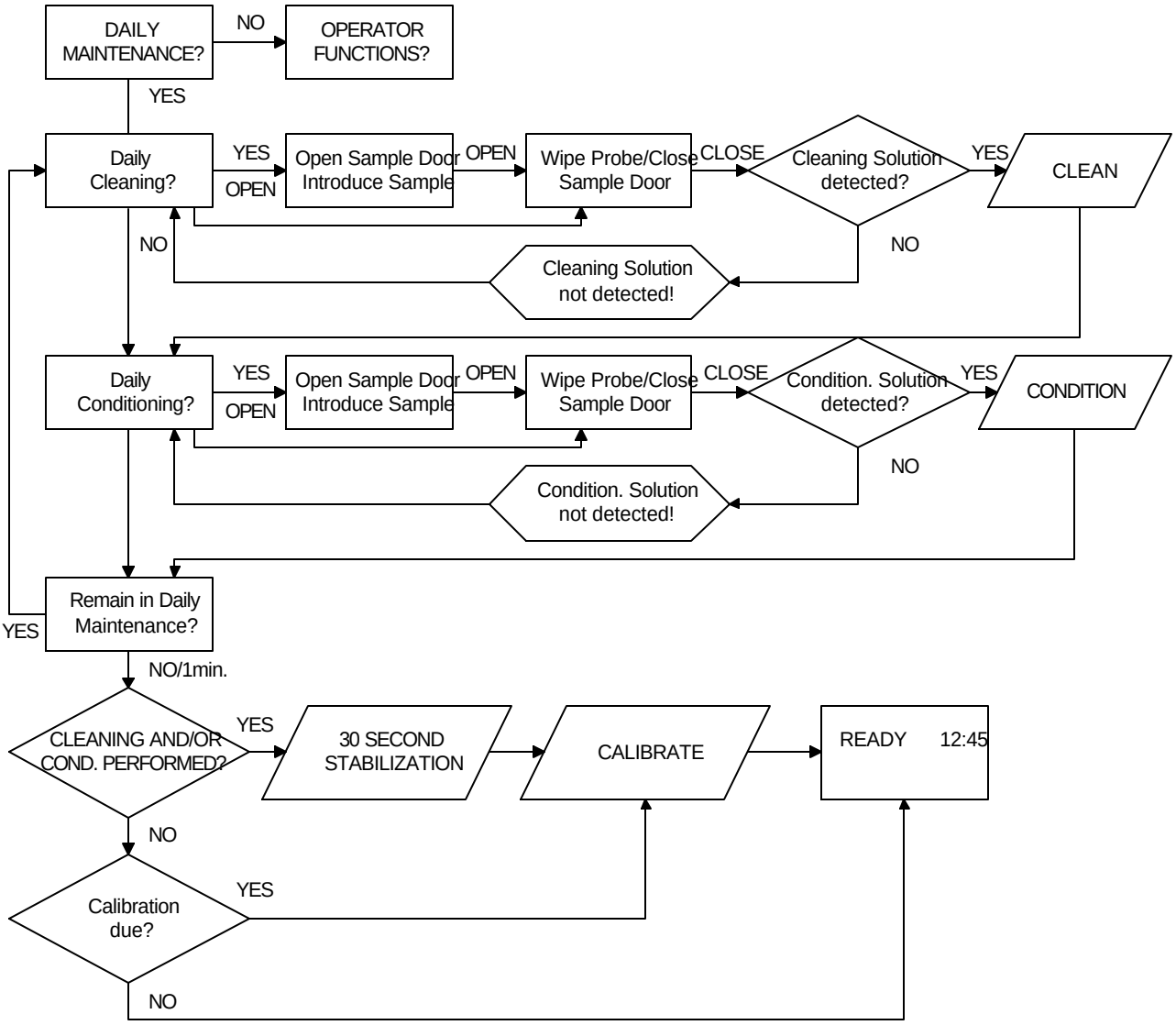
4 Print Functions Menu - 9120, 30, 40



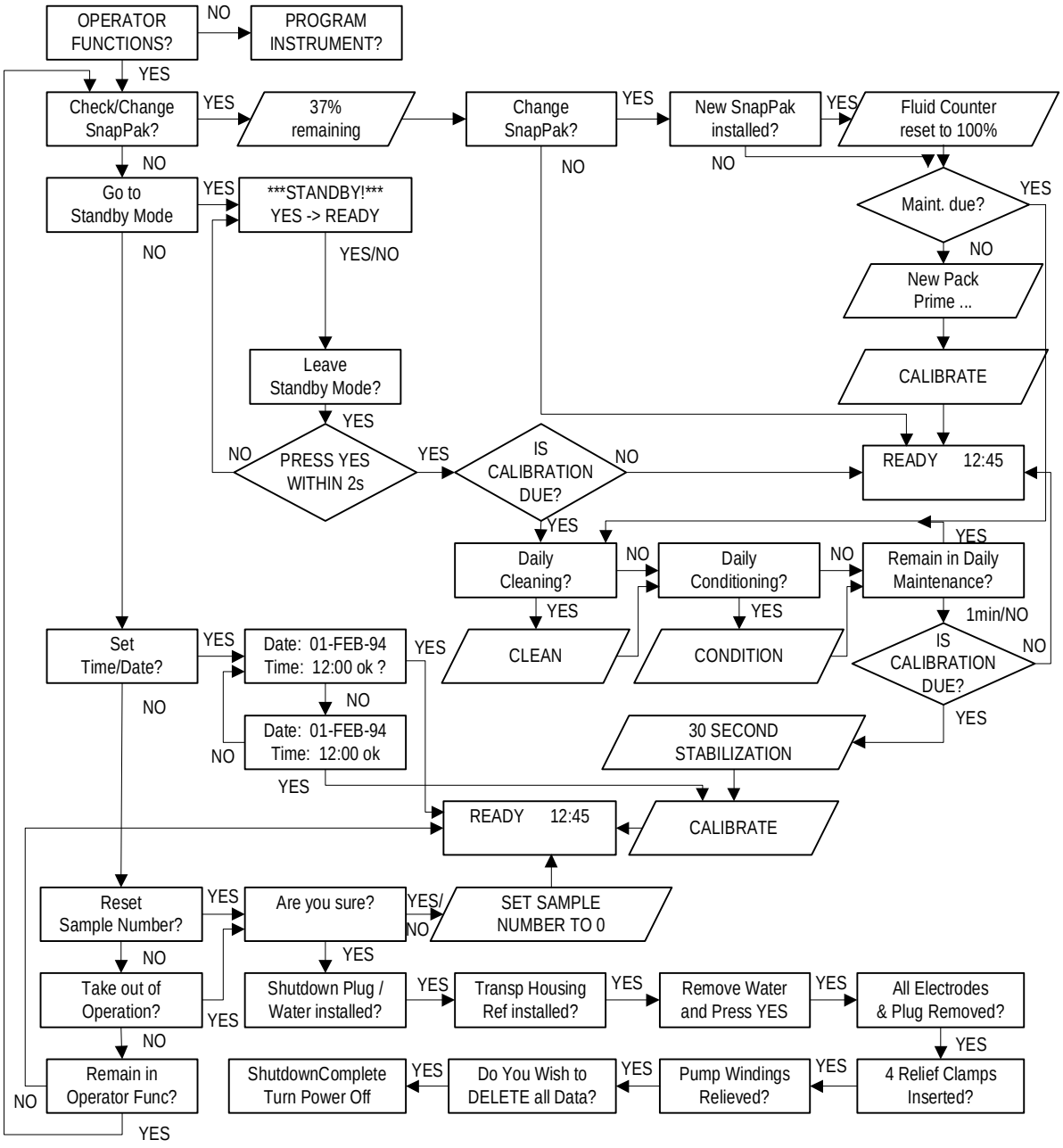
5 QC/Standard/Urine Sample Menu - 9120, 30, 40



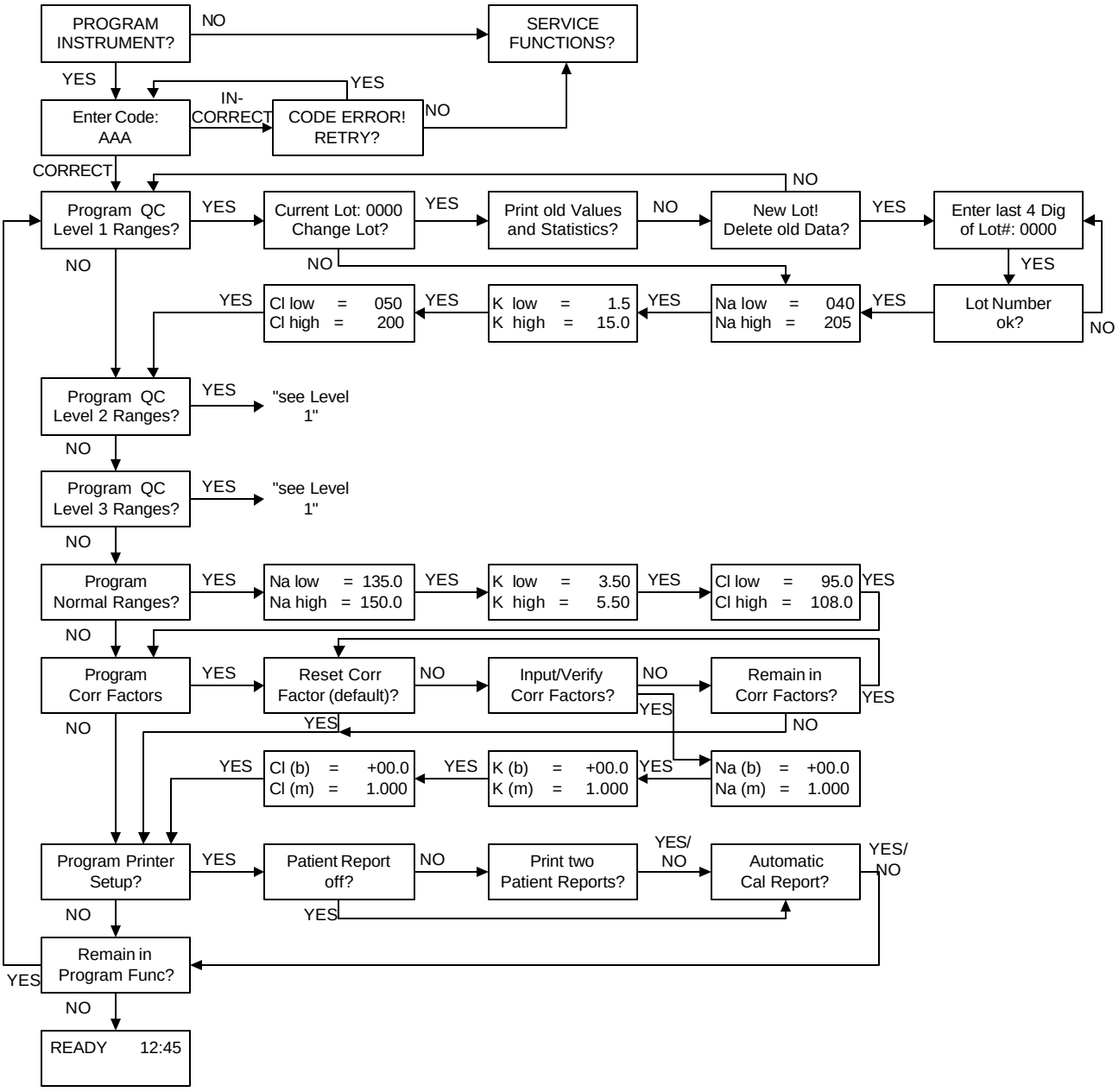
6 Daily Maintenance Menu - 9120, 30, 40



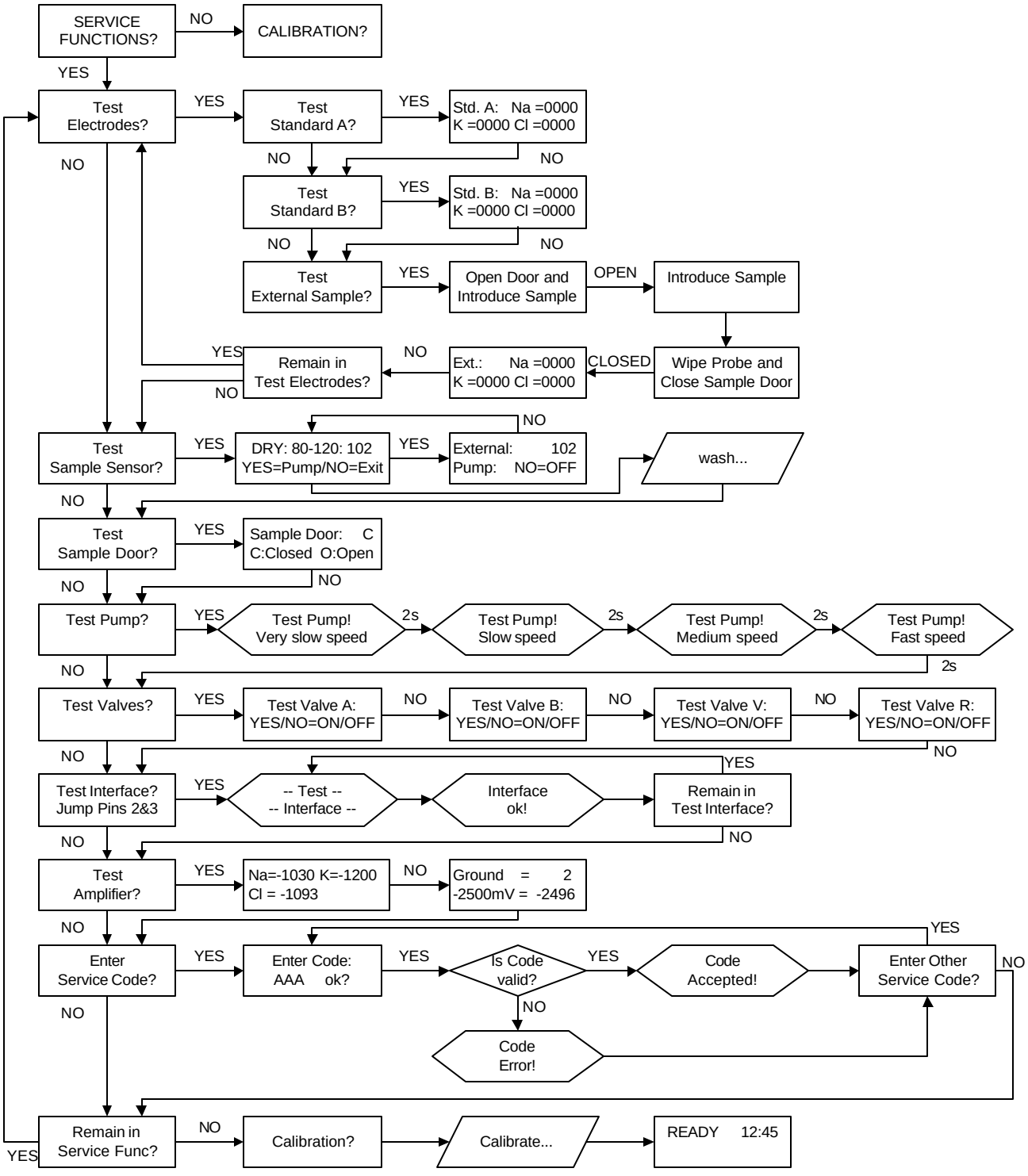
7 Operator Functions Menu - 9120, 30, 40



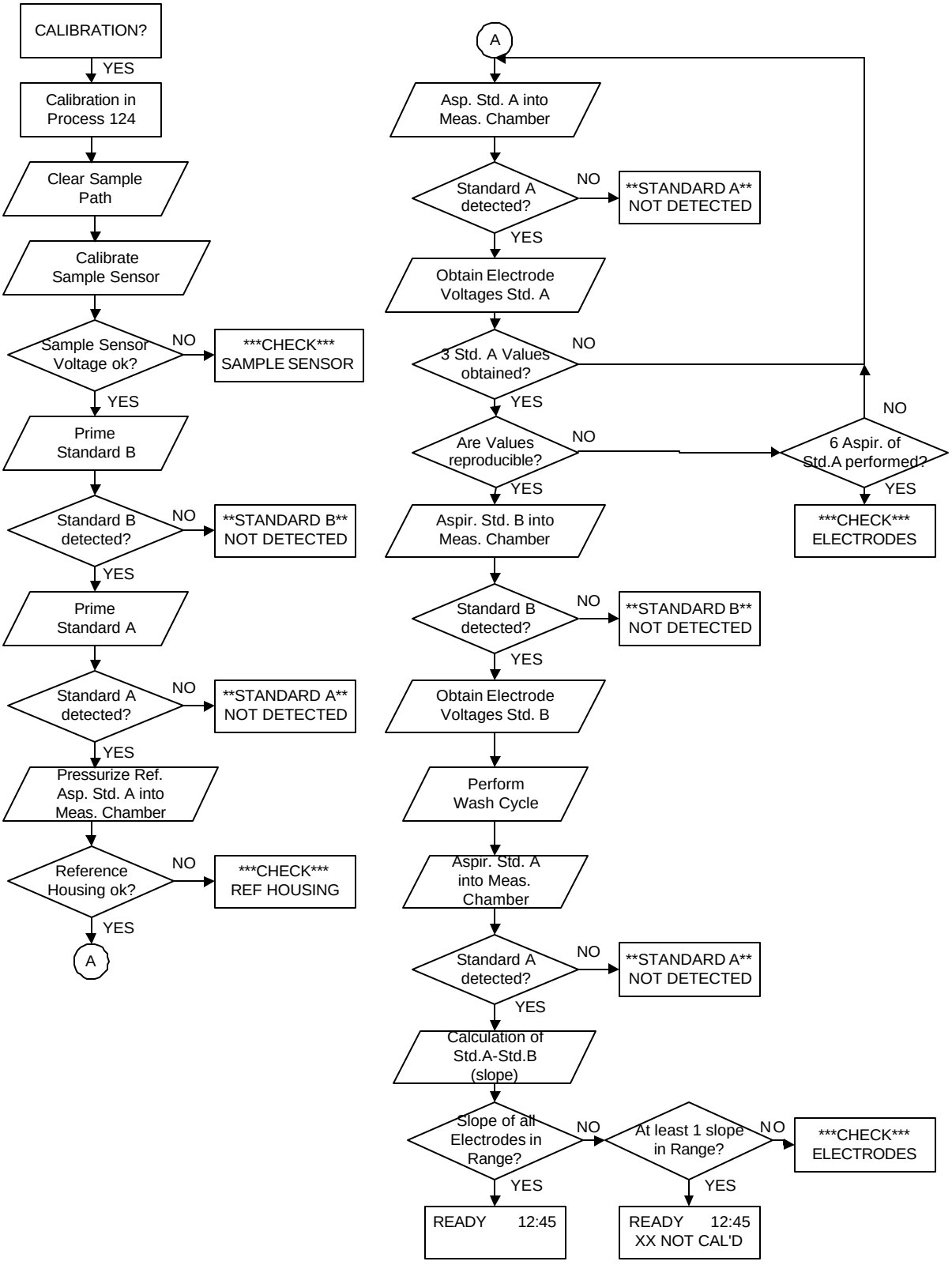
8 Program Instrument Menu - 9120, 30, 40



9 Service Functions Menu - 9120, 30, 40

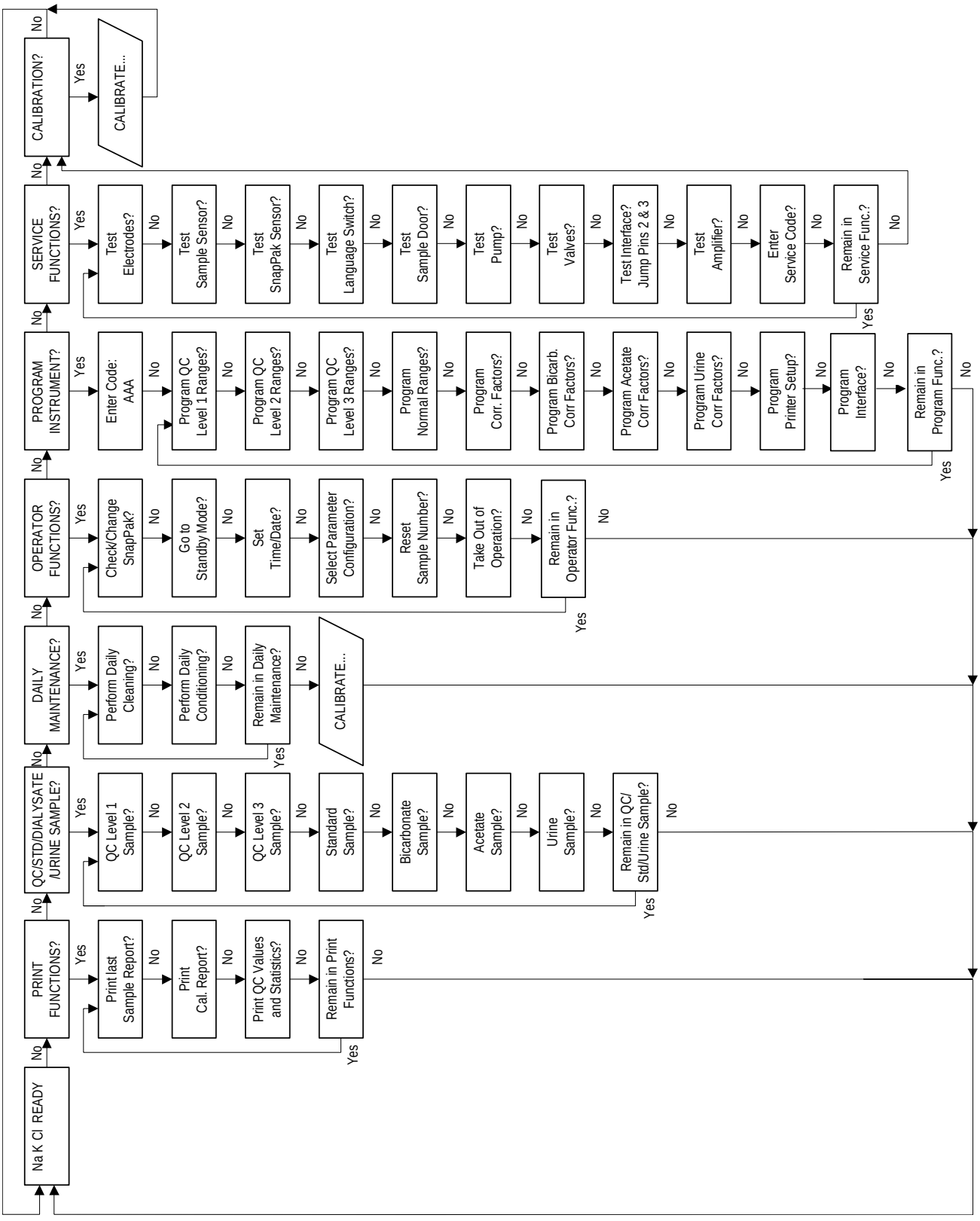


10 Calibration Sequence - 9120, 30, 40

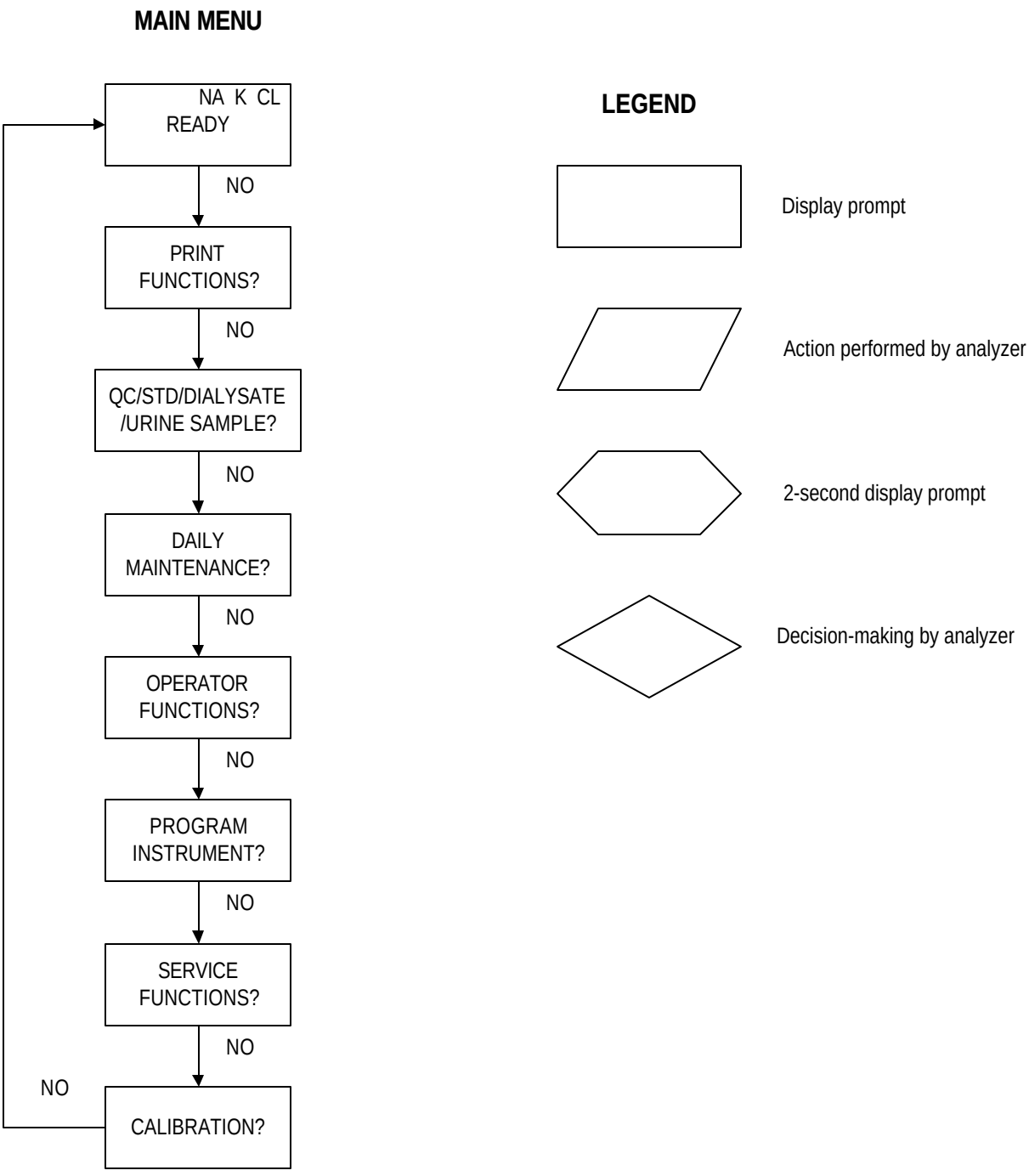


3.2 Software Operation - 9180

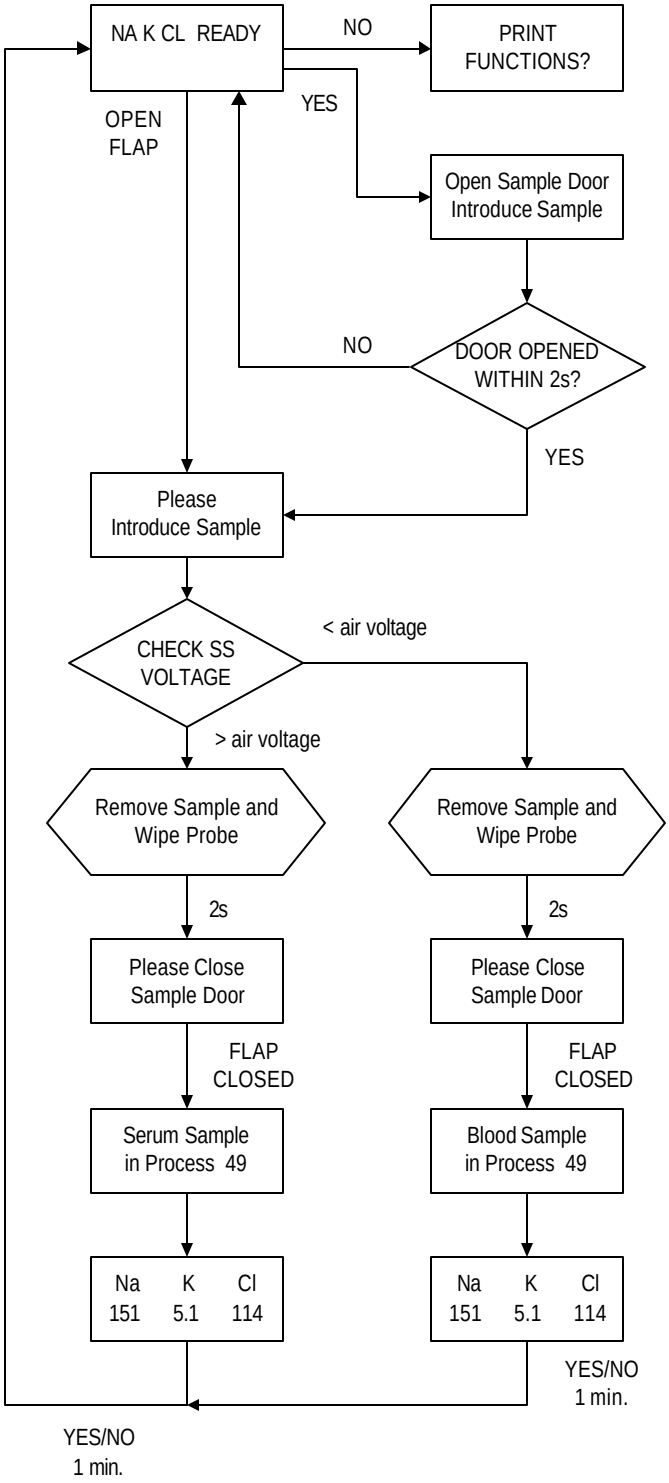
1 Overall Program Operating Flow - 9180



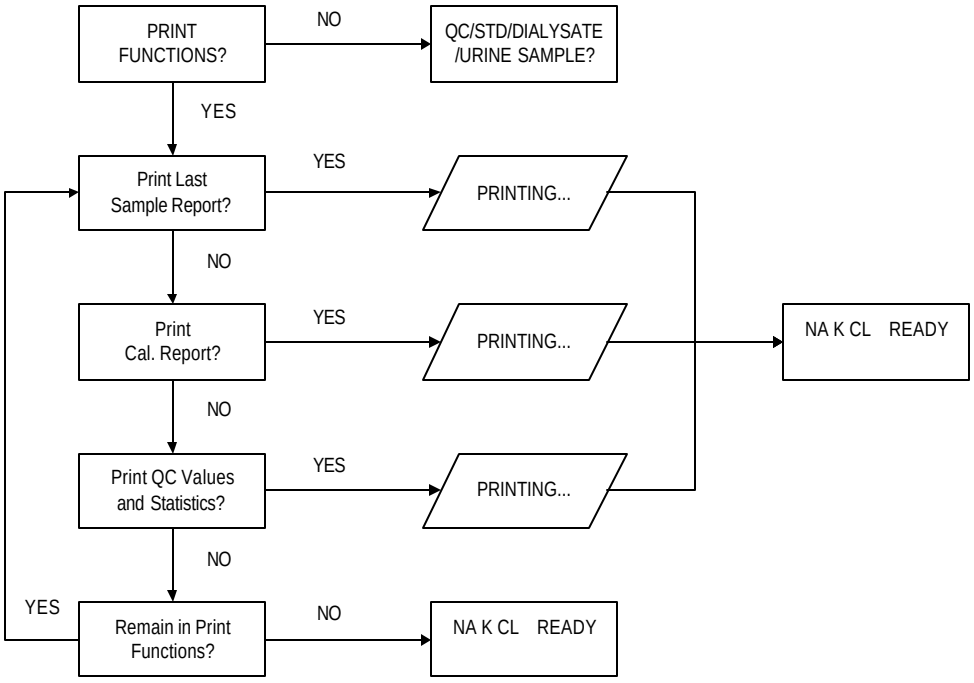
2 Main Menu - 9180



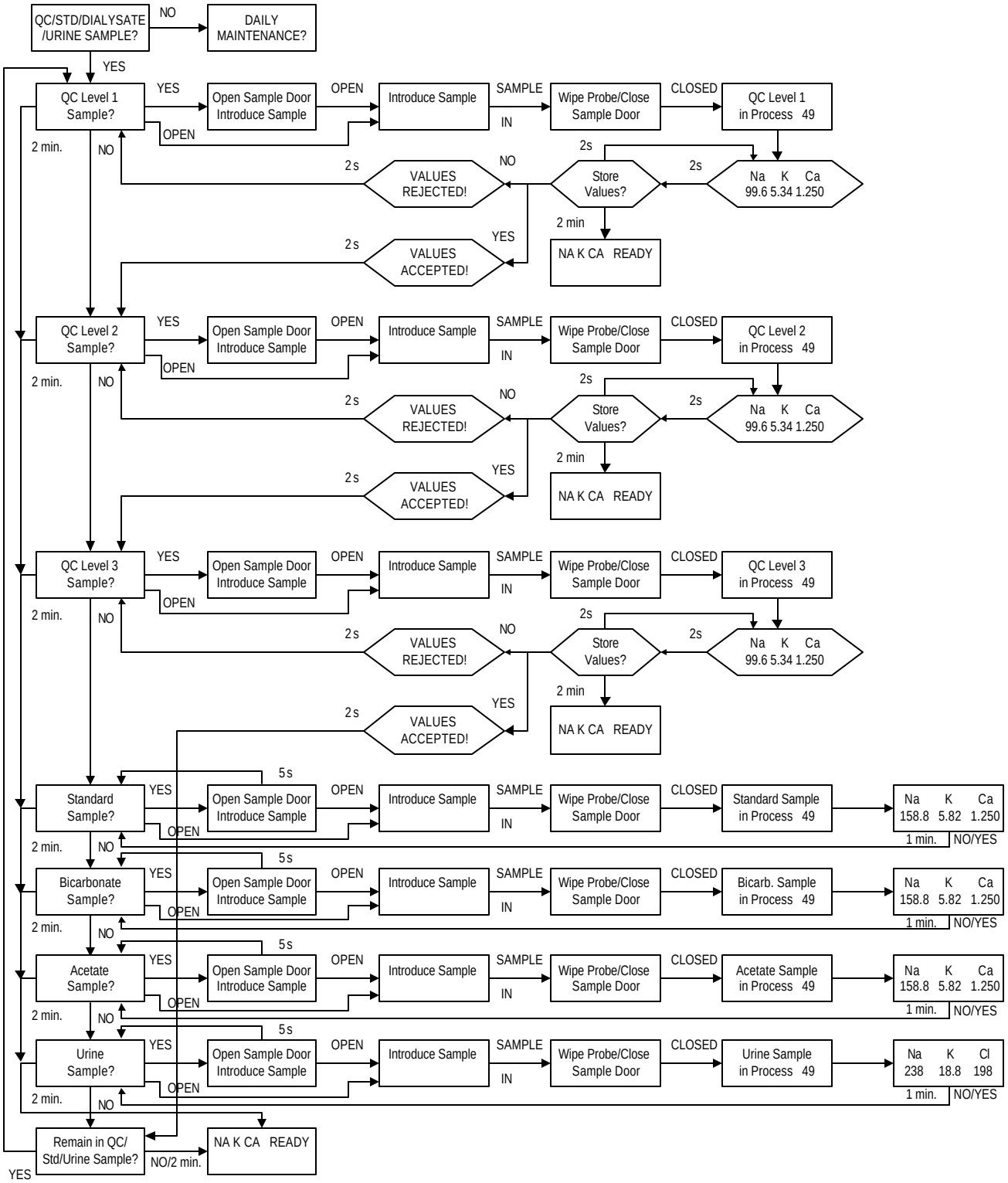
3 Measurement Sequence - 9180



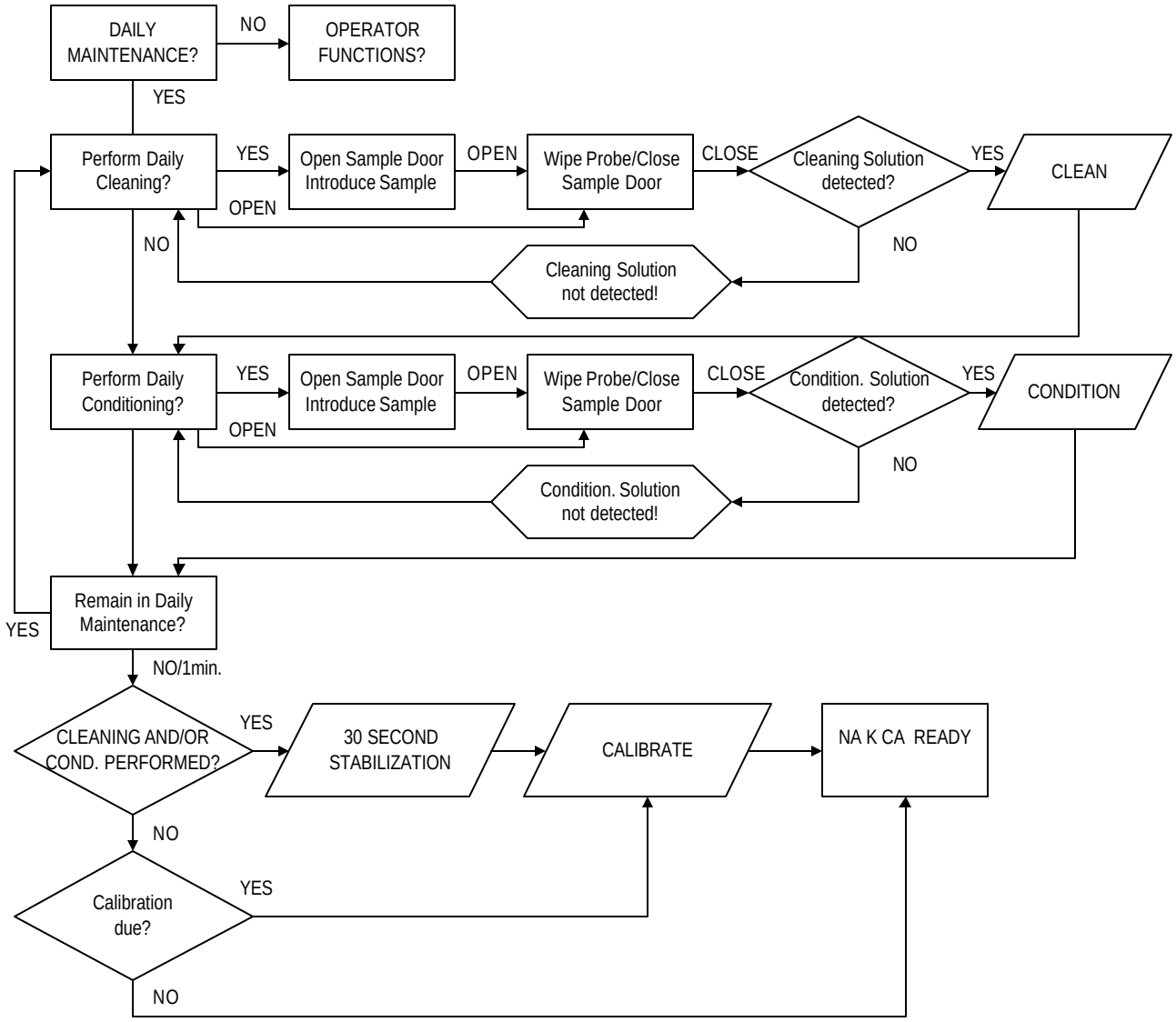
4 Print Functions Menu - 9180



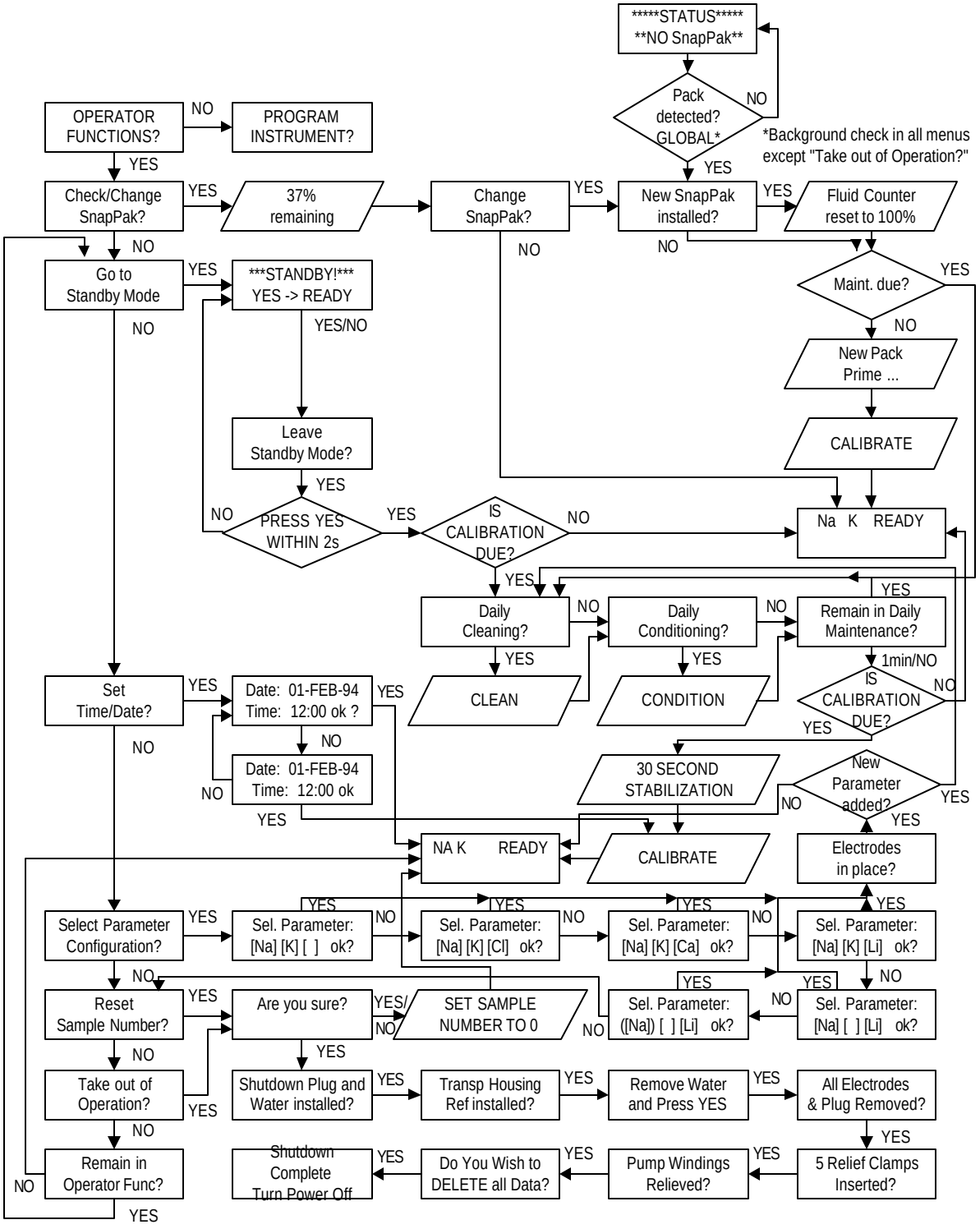
5 QC/Standard/Dialysate/Urine Sample Menu - 9180



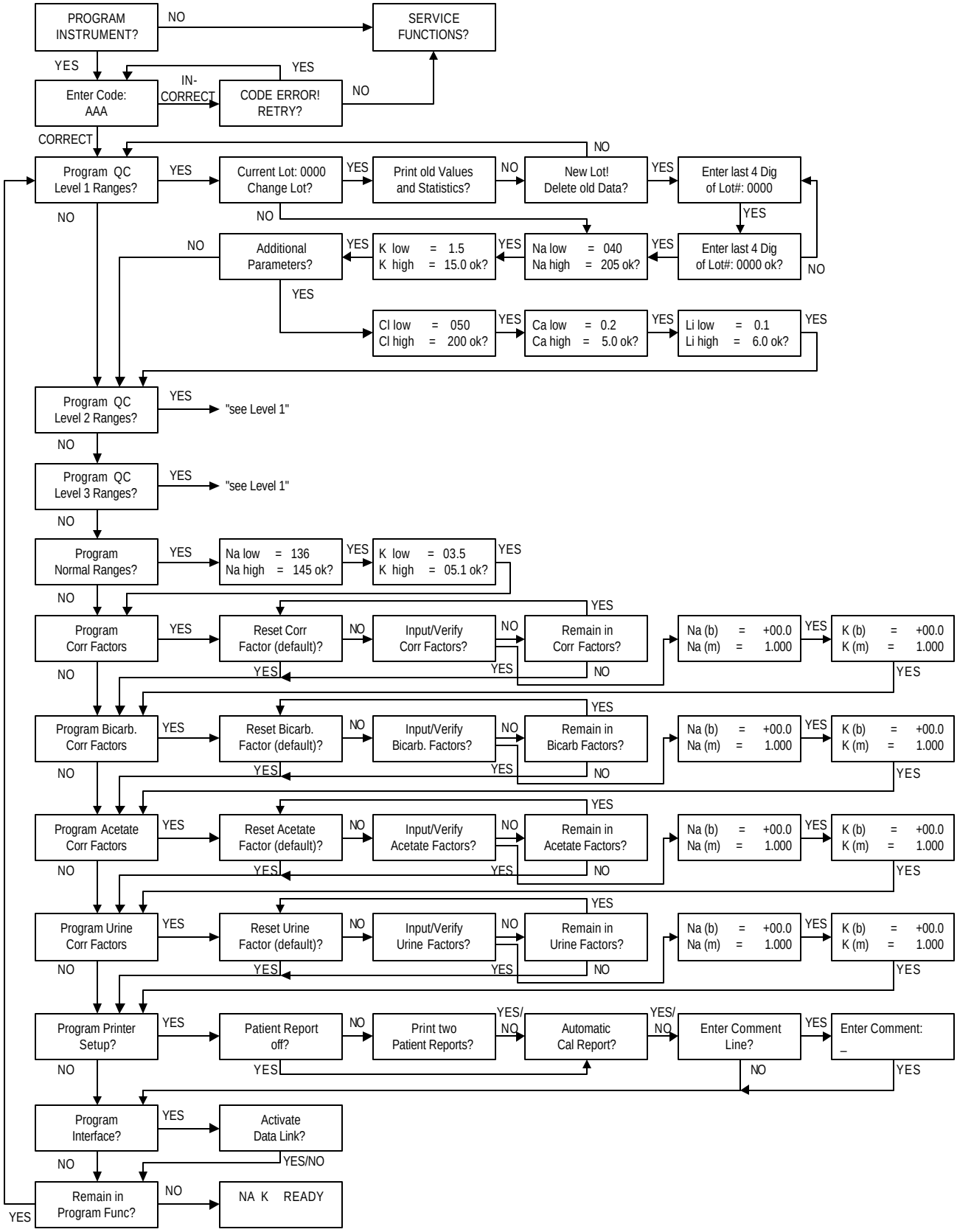
6 Daily Maintenance Menu - 9180



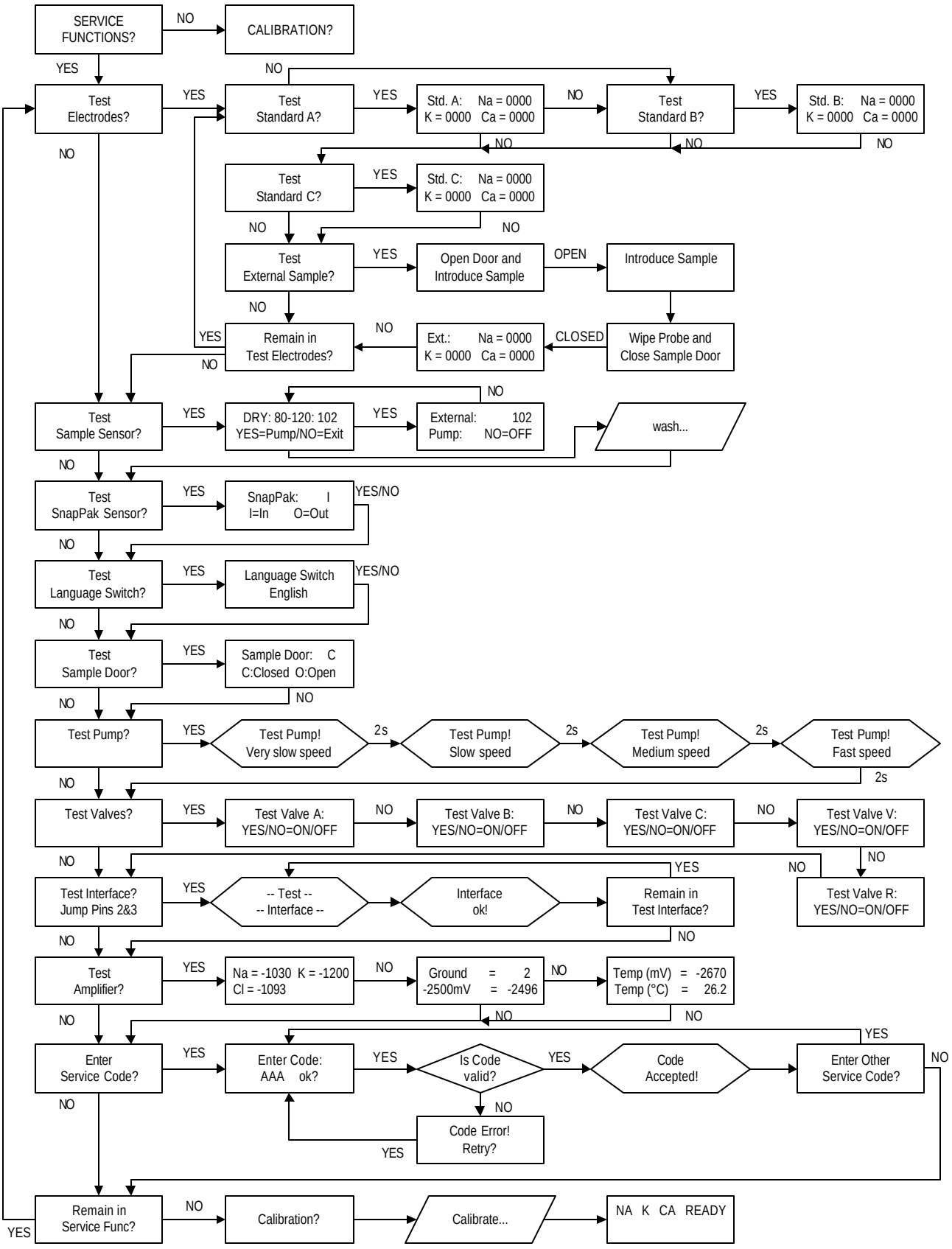
7 Operator Functions Menu - 9180



8 Program Instrument Menu - 9180

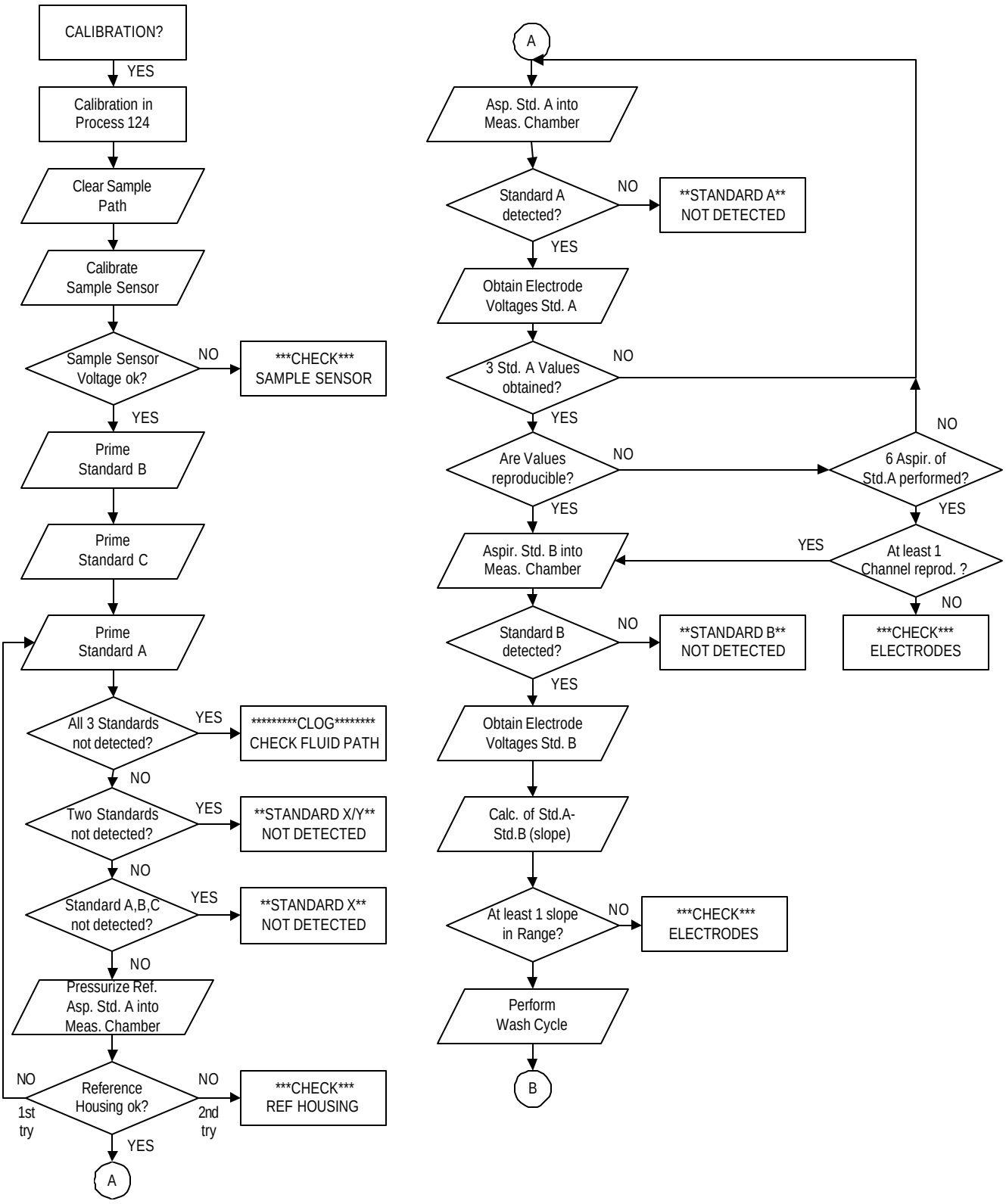


9 Service Functions Menu - 9180

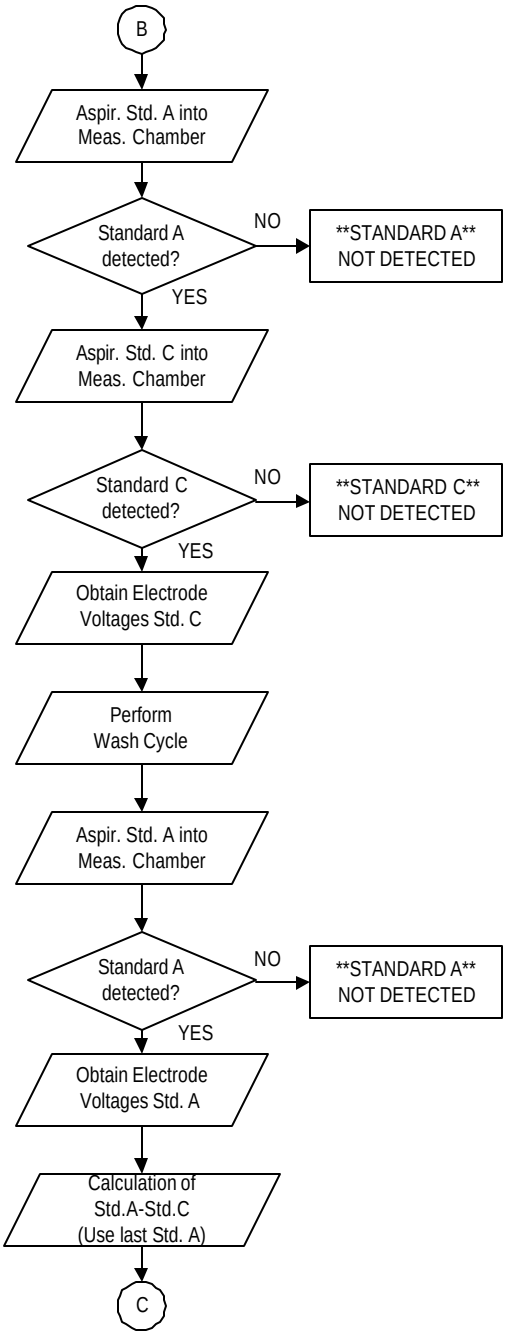


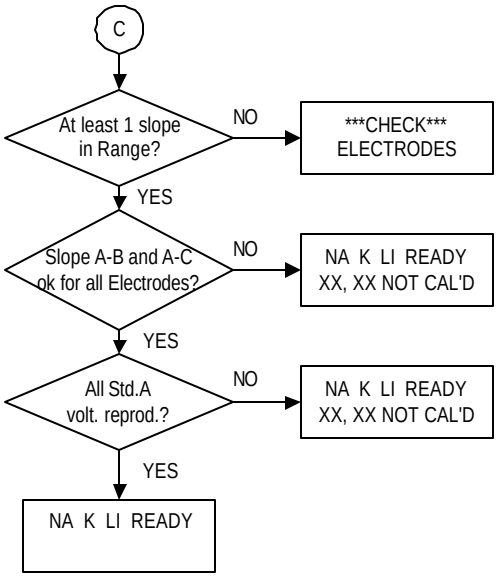
10 Calibration Sequence - 9180 (1)

(Example Na/K/Li Calibration)

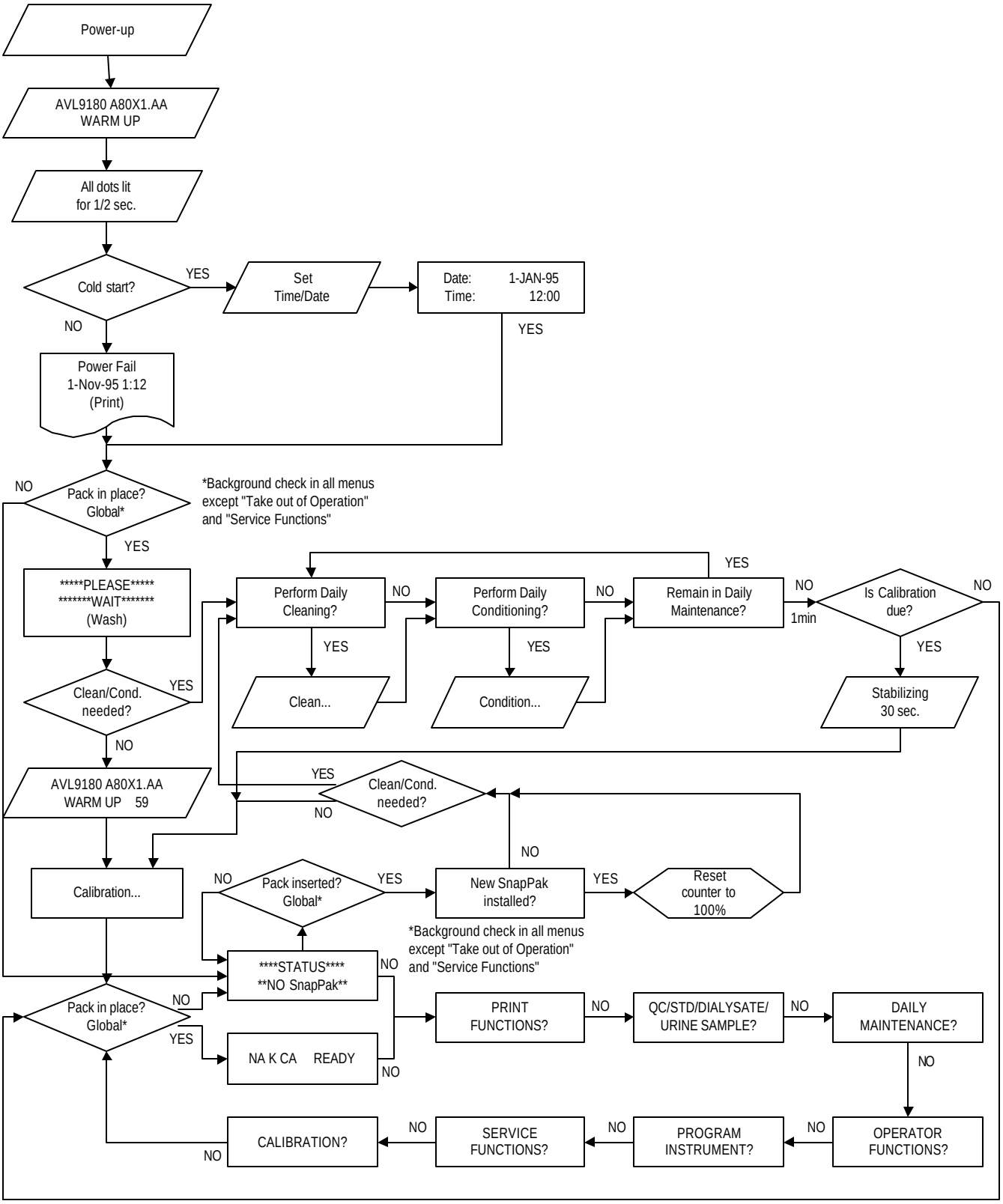


10 Calibration Sequence - 9180 (2)



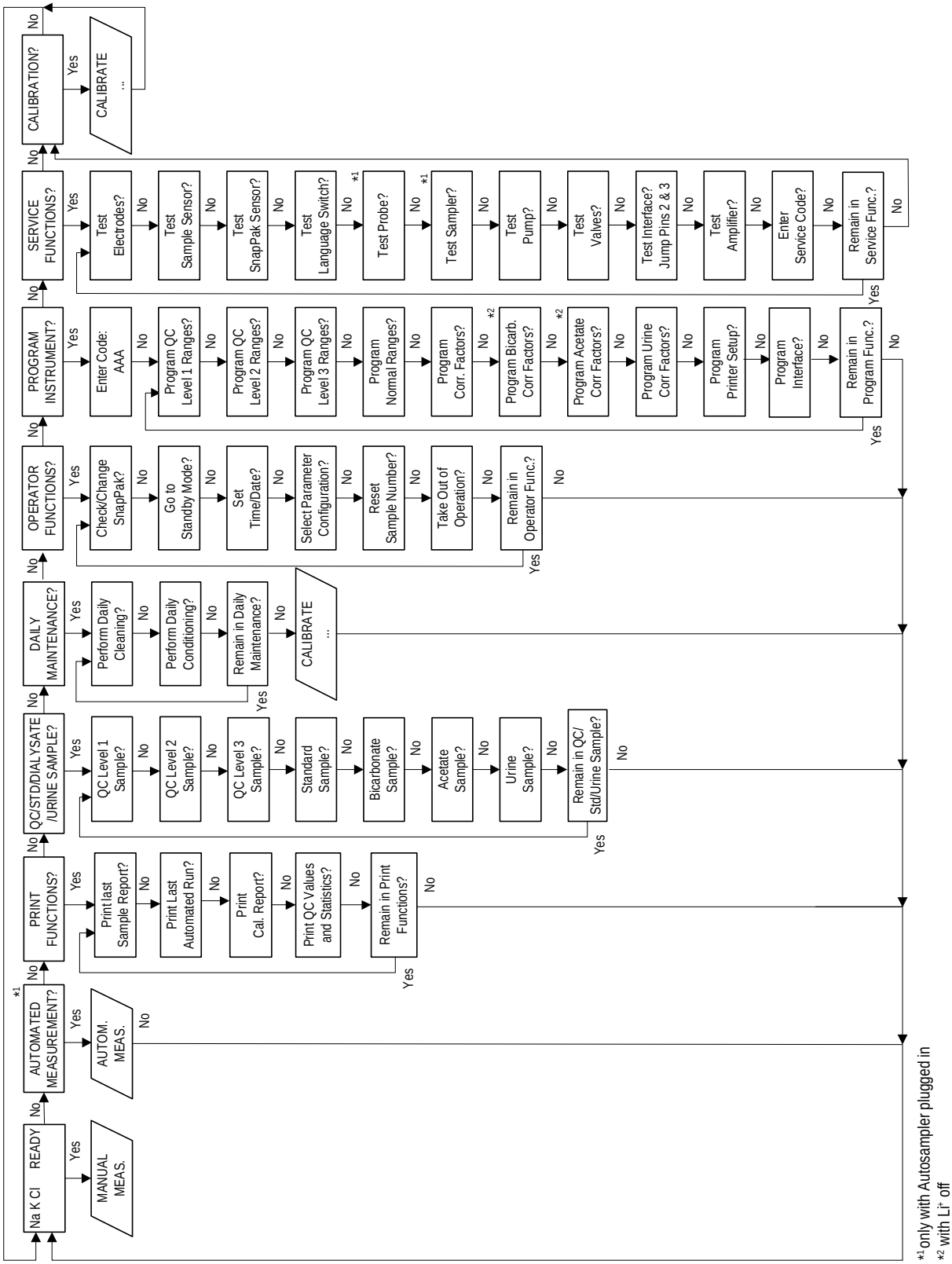


11 Power-up - 9180

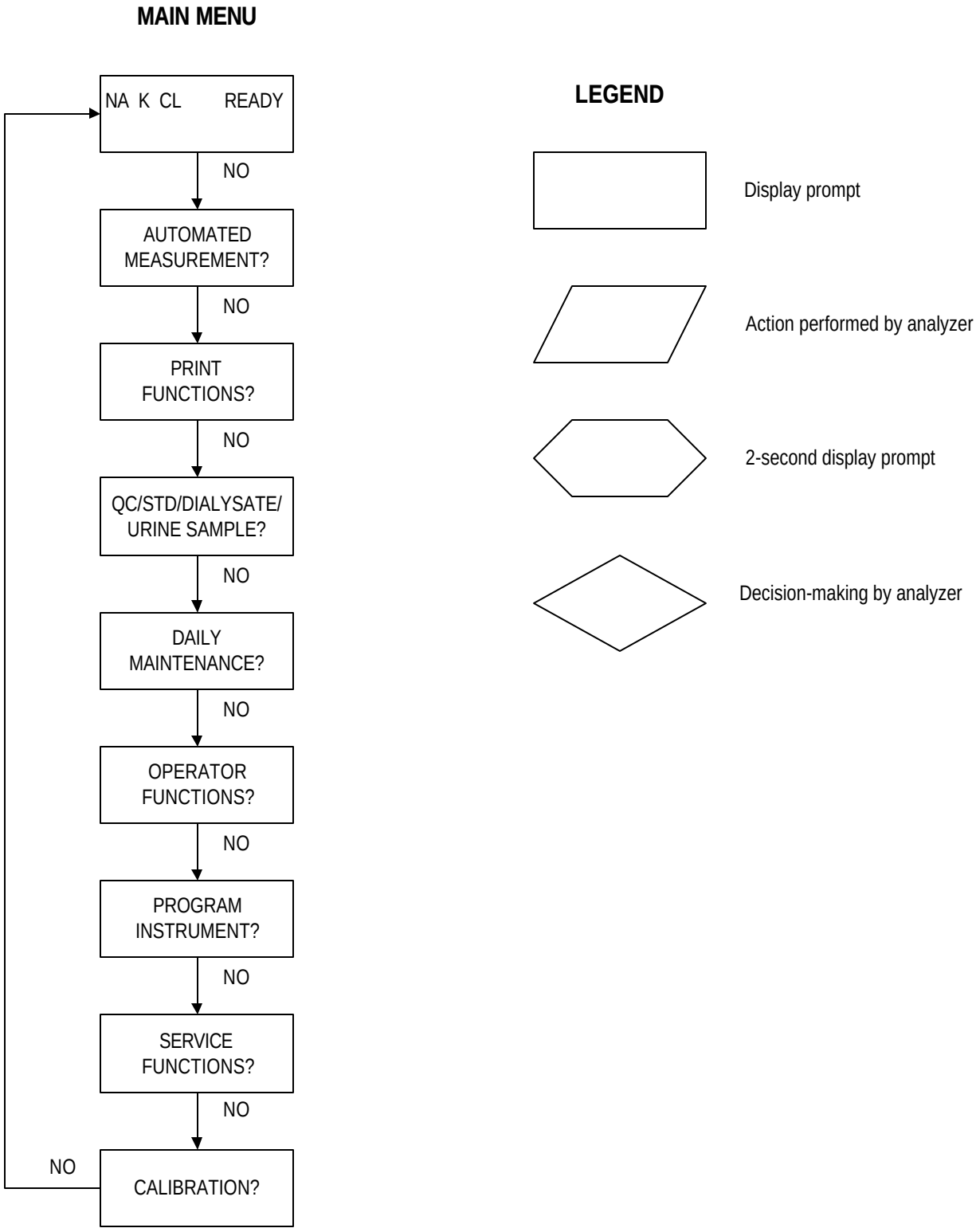


3.3 Software Operation - 9181

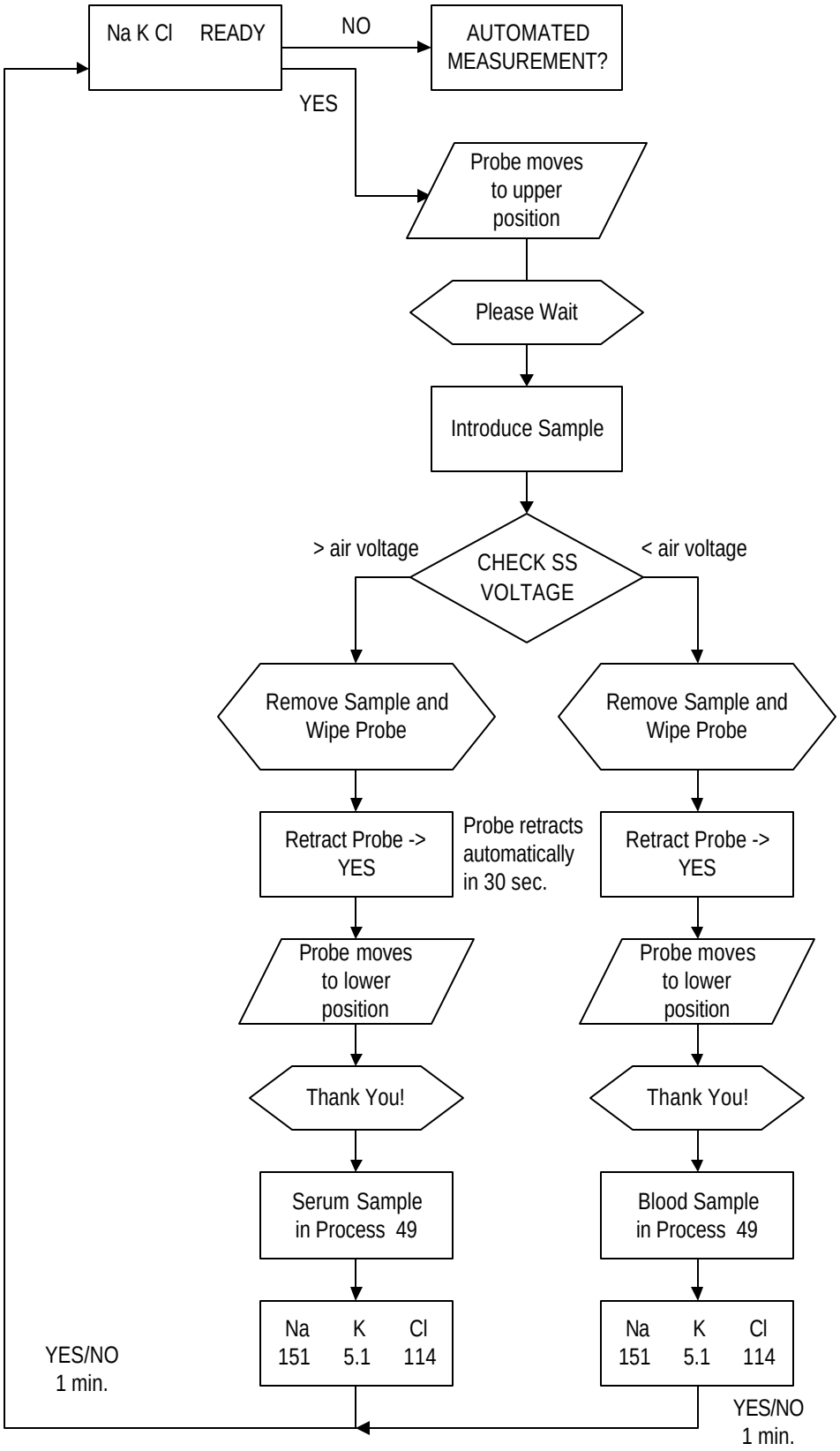
1 Overall Program Operating Flow - 9181



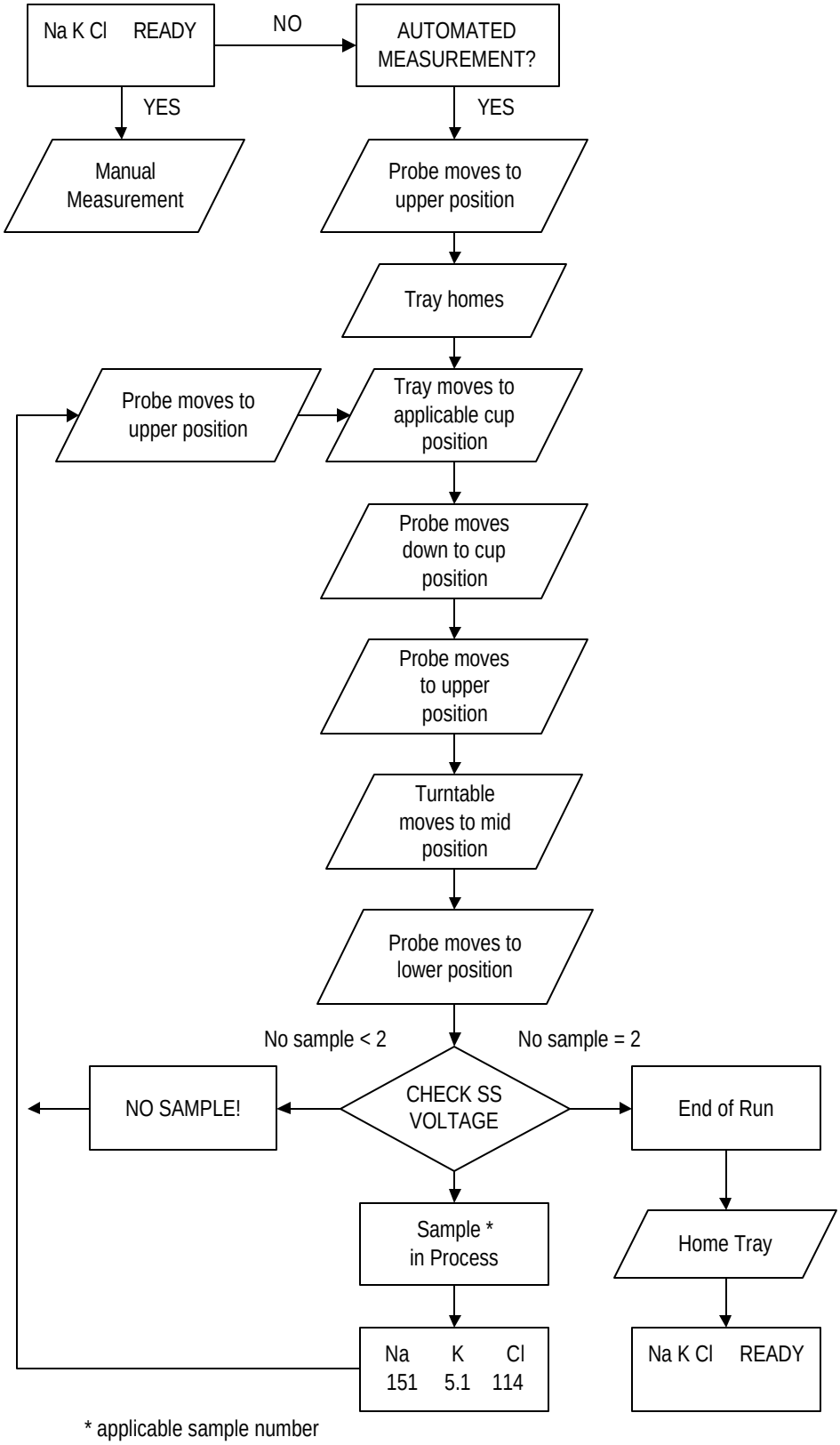
2 Main Menu - 9181



3 Manual Measurement Sequence - 9181

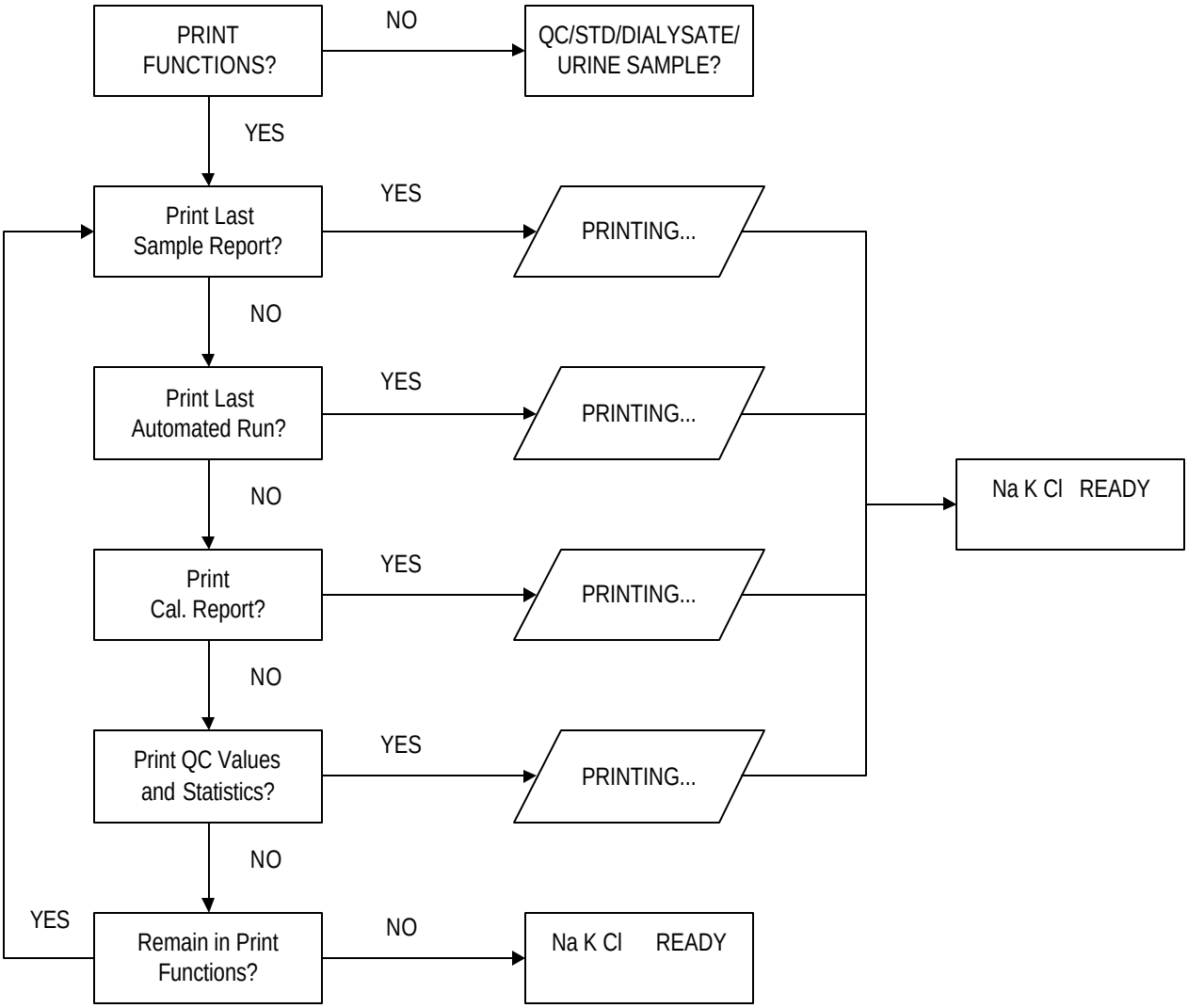


4 Automated Measurement Sequence - 9181

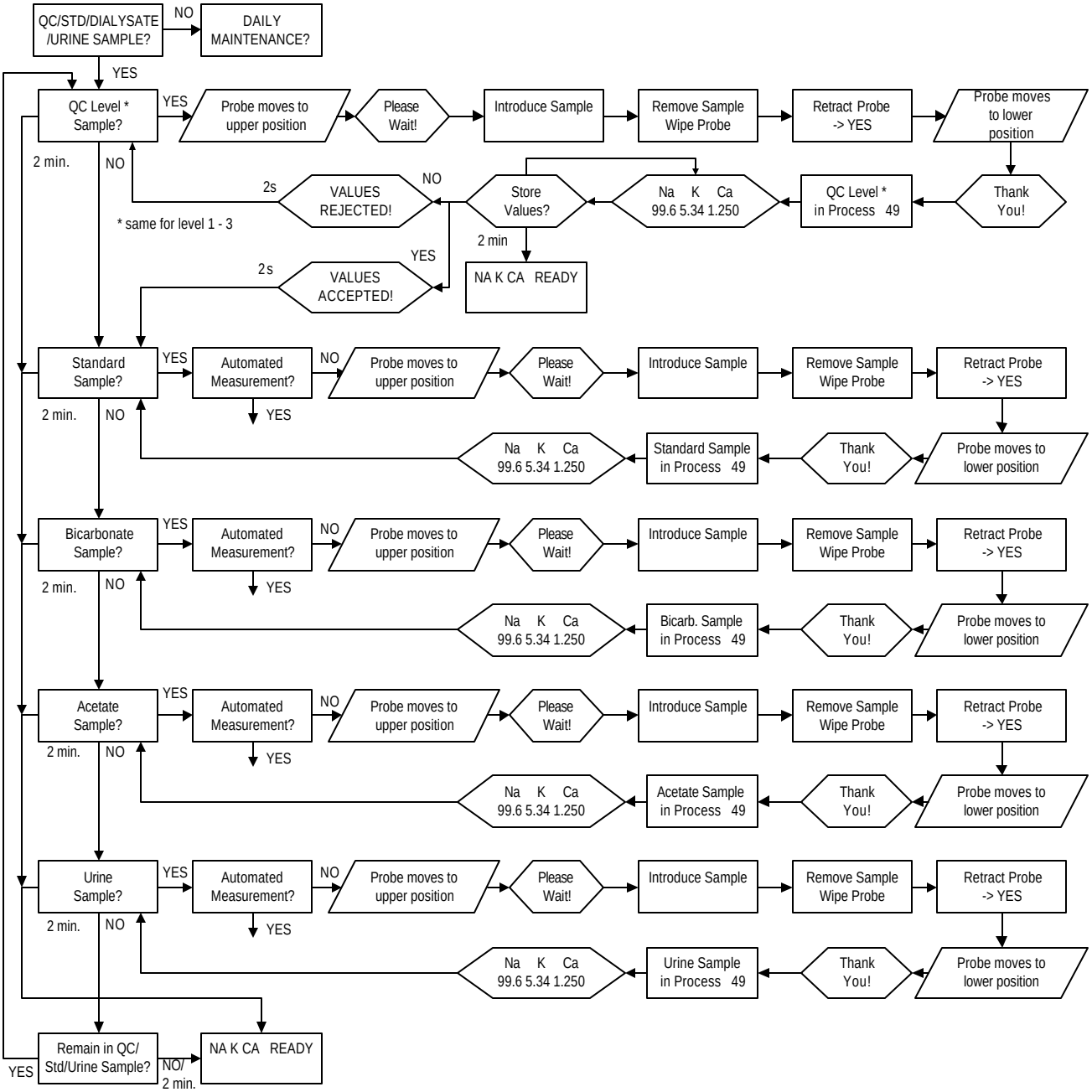


* applicable sample number

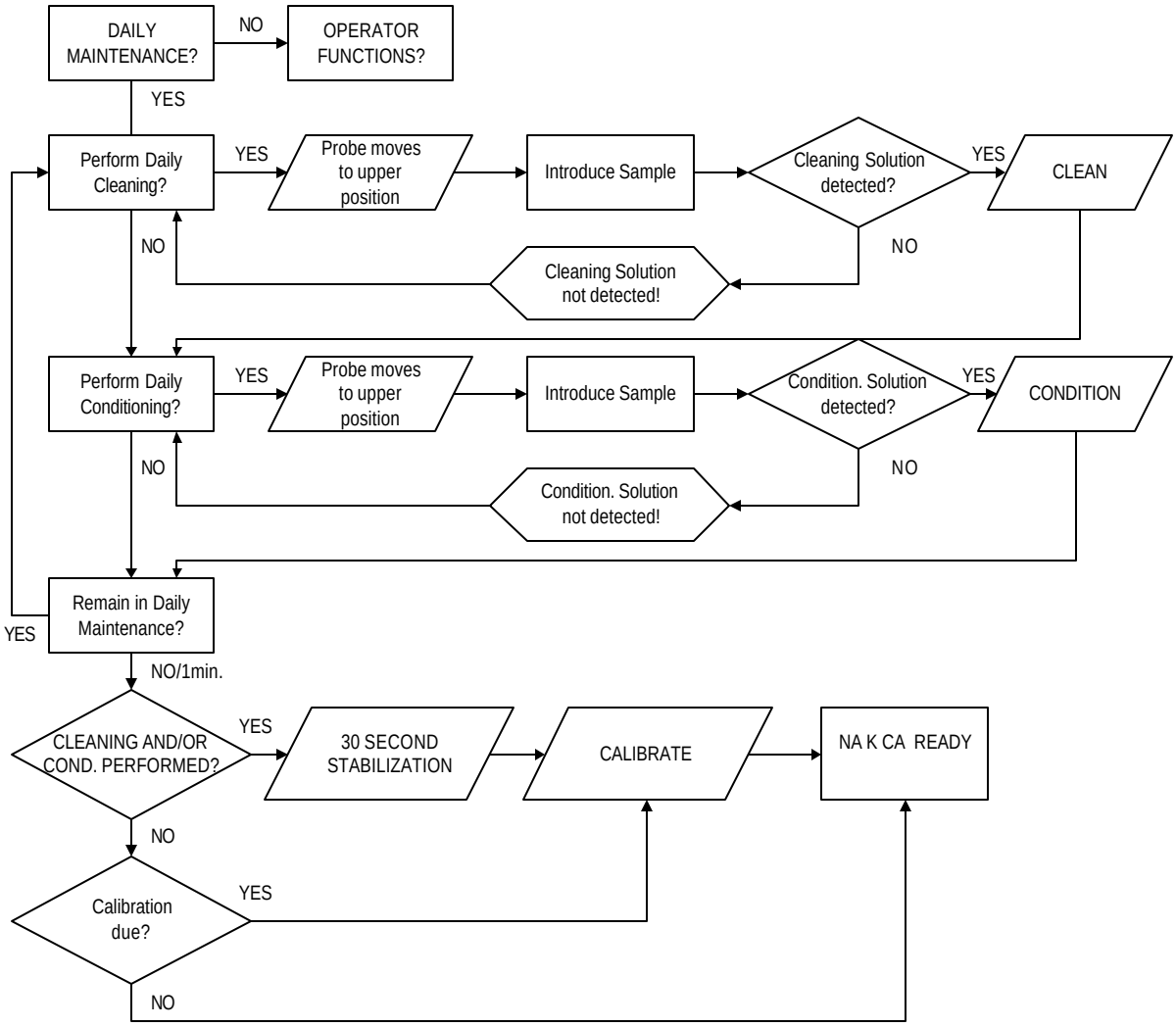
5 Print Functions Menu - 9181



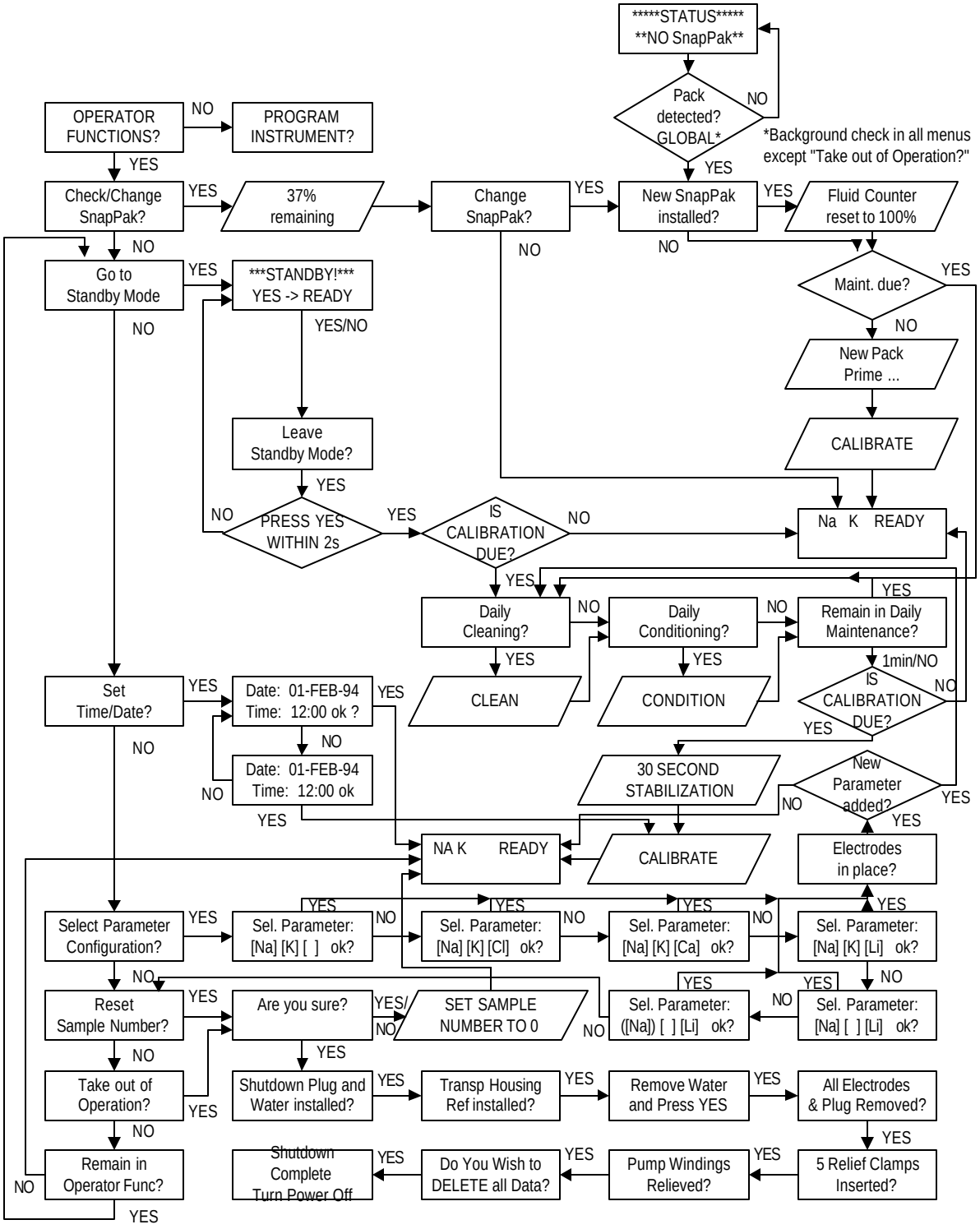
6 QC/Standard/Dialysate/Urine Sample Menu - 9181



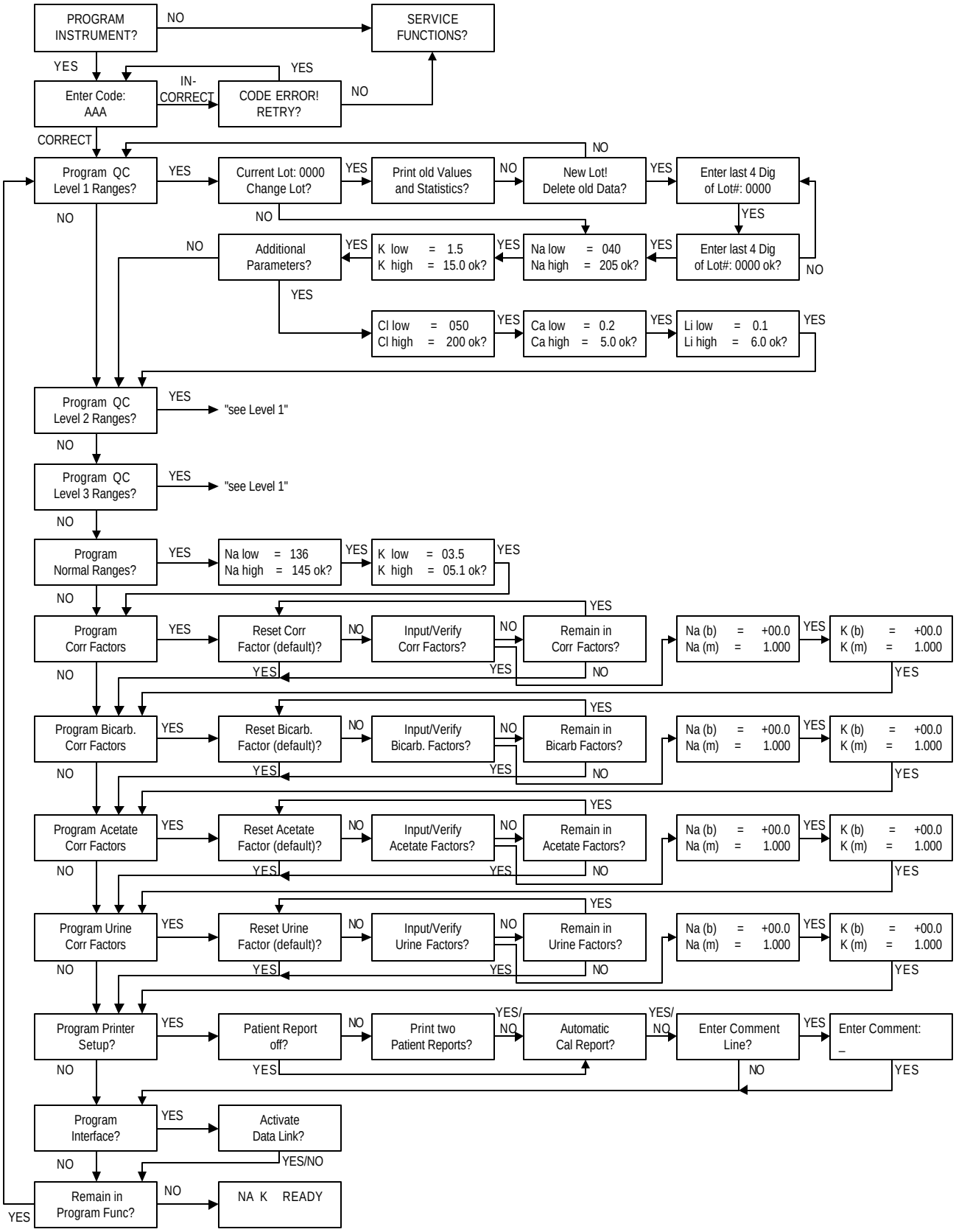
7 Daily Maintenance Menu - 9181



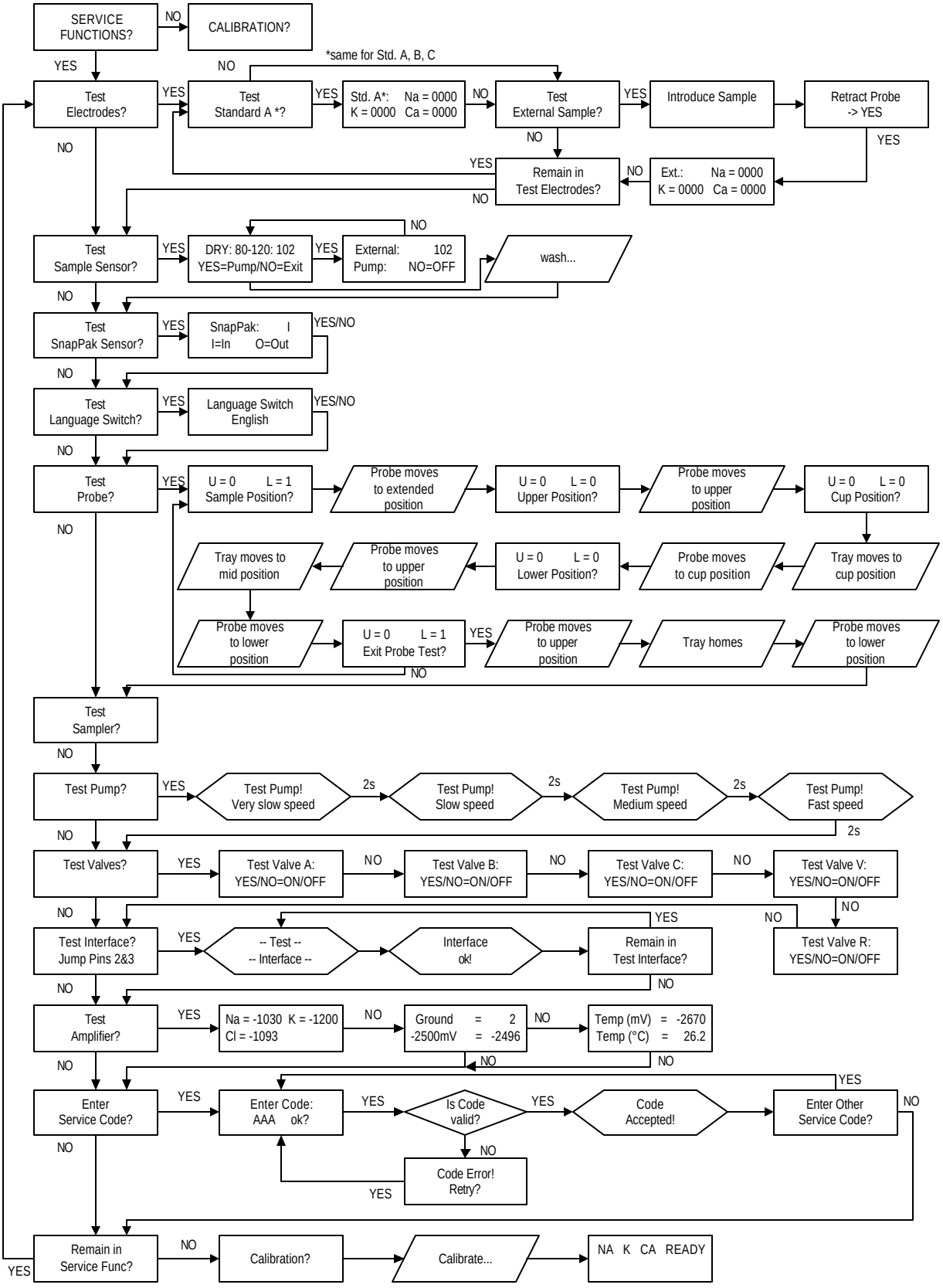
8 Operator Functions Menu - 9181



9 Program Instrument Menu - 9181

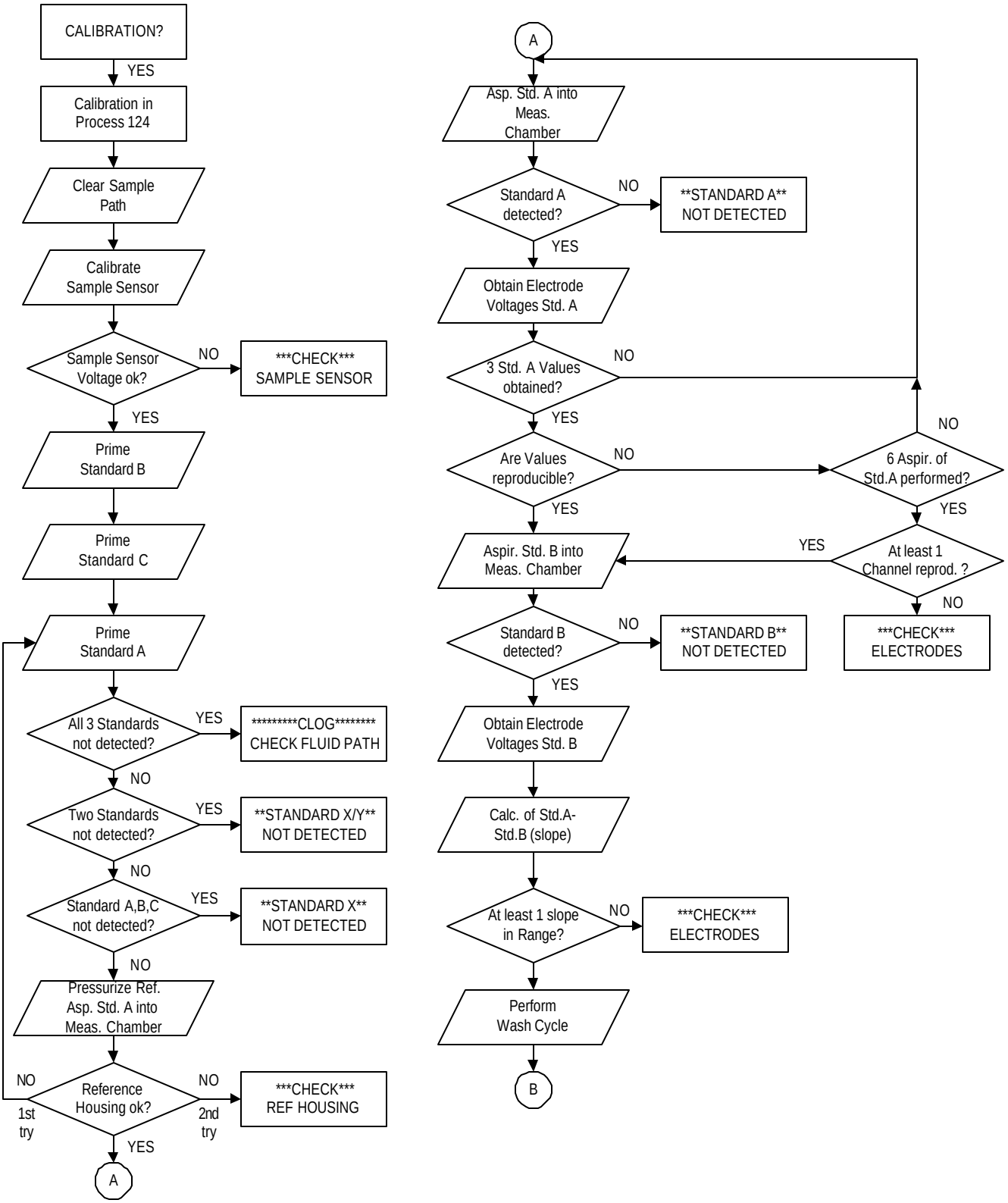


10 Service Functions Menu - 9181

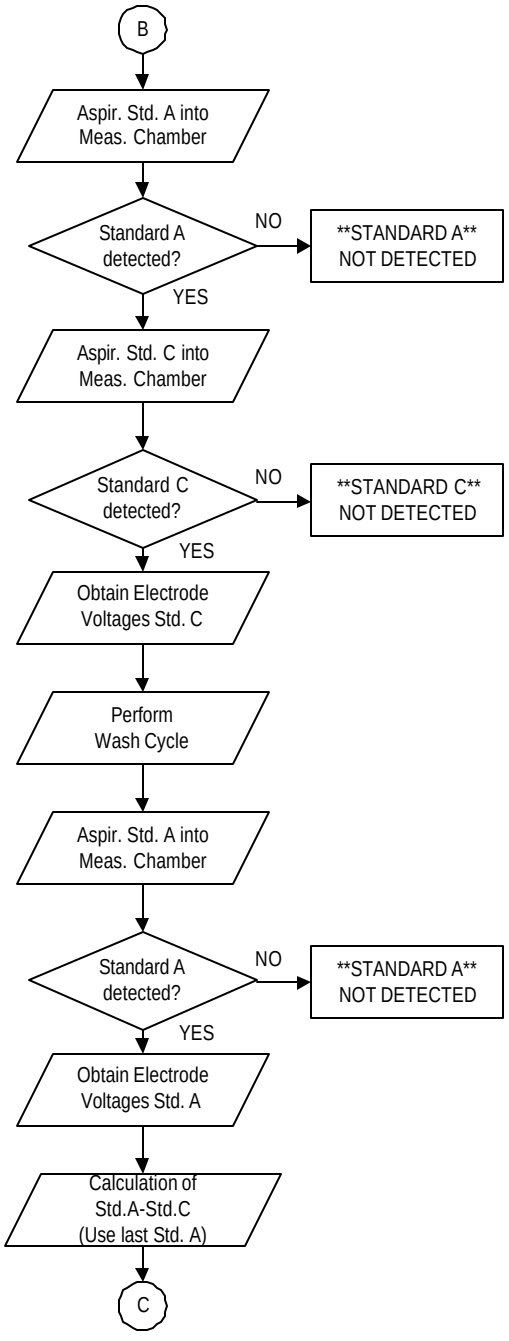


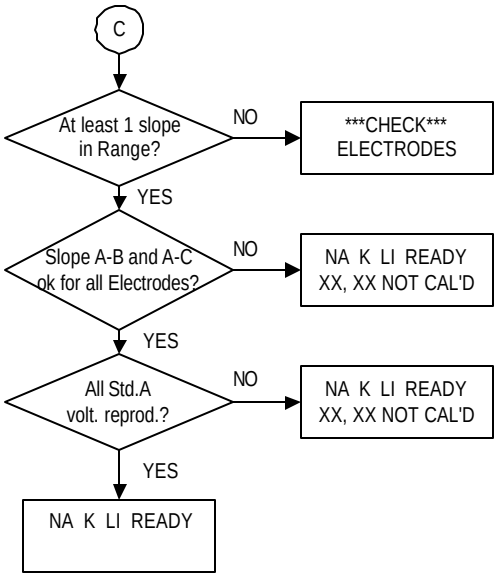
11 Calibration Sequence - 9181 (1)

(Example Na/K/Li Calibration)

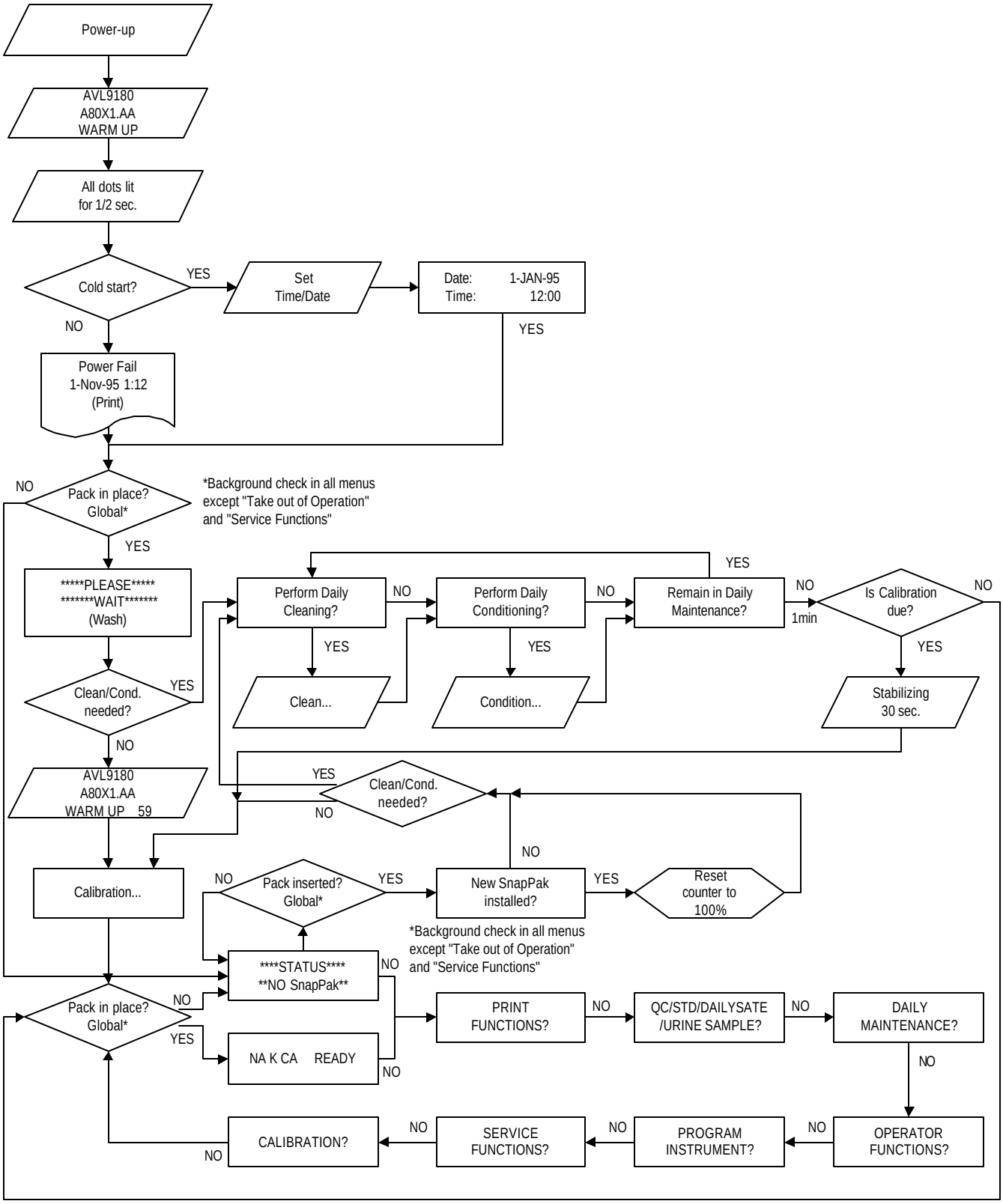


11 Calibration Sequence - 9181 (2)





12 Power-up - 9181



3.4 Service Functions

The Service Functions mode provides a menu of service test functions to assist in failure diagnosis and identification. A logic flow chart is provided for reference of the sequences included in the Service Functions mode.

TEST ELECTRODES

This mode allows for the measurement and display of electrode voltages. Standard A, Standard B or an external sample can be measured to determine electrode performance and provide measurement data useful in locating electrode calibration faults. Each electrode parameter will be displayed and the electrode voltage associated with the sample type selected can be observed.

Example Displays:

Std. A: Na=1582 K= 654 Cl=-904

Std. B: Na=237 K=-988 Cl=647

Ext: Na=1321 K=-598 Cl= -127

TEST SAMPLE SENSOR

In this mode, the sample sensor output is displayed which is useful for electrical adjustment or for troubleshooting sample sensor faults. A dry sample sensor should display a value of 100 with a range of 80 to 120. After verifying a dry sensor, aspiration of a clear fluid (i.e., water) should increase the displayed value by at least 40 units.

Example Display:

DRY 80-120: 102 YES=Pump/No=Exit

External: 153 Pump: NO=OFF

TEST SnapPak SENSOR (9180 and 9181 only)

In this test, the SnapPak Sensor detects whether the ISE SnapPak™ is in place. "I" indicates that the ISE SnapPak™ is in place, "O" indicates that it is either not present or not completely seated.

Example Display:

SnapPak: I I = IN O = OUT

TEST LANGUAGE SWITCH (9180 and 9181 only)

This mode displays the language selected for display and printout. To change the selection, set the language switch (located behind printer) to the desired language. The display will indicate the language choice according to the switch setting. To activate a new language, turn the analyzer off and back on with the switch set to the desired language.

Example Display:

Lanugage Switch English

TEST SAMPLE DOOR (except 9181)

This test verifies the operation of the sample door light gate and its associated circuitry. The display indicates an “O” or “C” depending on the position of the door.

Example Display:

Sample Door: C C:Closed/O:Open

TEST PROBE (9181 only)

This test verifies the operation of the sample probe motor, position sensor and associated circuitry. The "U" represents the output of the upper position sensor, the "L" represents the output of the lower position sensor.

Example Display:

```
U = 0       L = 1
Sample Position?
```

TEST AUTOSAMPLER (9181 only)

This test verifies the operation of the Autosampler turntable assembly. The display indicates the output of both the position and home sensors.

Note: If the Autosampler is not plugged in or the TABLE PRESENT *bit is not activated, this test will not appear under the* SERVICE FUNCTIONS *menu.*

Example Display:

```
Home: 0
Pos = 1
```

TEST PUMP

This test turns on the peristaltic pump at each of the four pump speeds. The display indicates for two seconds each pump speed while each pump speed is being tested. Observe that the peristaltic pump changes speed as is indicated on the display.

```
*** Pump Test ***
  Very Slow Speed
```

```
*** Pump Test ***
    Slow Speed
```

```
*** Pump Test ***
   Medium Speed
```

```
*** Pump Test ***
    Fast Speed
```

TEST PINCH VALVES

This test turns on/off each solenoid valve as indicated and is useful to verify both electronic control and mechanical operation of each solenoid valve.

TEST INTERFACE

The Interface Test can be used to verify correct operation of the RS232C serial port. To operate this test, jumper pin 2 and pin 3 of the rear interface connector prior to invoking the test. During the interface test, the analyzer sends out a test string and checks if it is received within a set period of time. If correct operation is observed after completion of the test, **INTERFACE OK** will be displayed.

TEST AMPLIFIER

The Amplifier Test displays ground, reference and output voltage of each input amplifier. The values displayed for each electrode channel will be dependent on the electrode inputs and may vary. Display of the ground should read between -10mV and +10mV with the reference voltage reading between -2490mV and -2510mV. With all inputs open, the display should read +/- 4095 for each channel. On the 9140/ 9180/9181, an additional display indicating the temperature voltage and temperature in degrees C is available to verify the temperature adjustment.

ENTER SERVICE CODE

Service Codes are available and allow additional programming features. Following is a listing of the available Service Codes and functions:

Set	Reset	Service Code Description
ALL (9181 only)	**LLA**	This service code will enable the Ca^{++} value during automatic serum/blood measurement. Special precautions are necessary to obtain the correct Ca^{++} value due to sample exposure to room air.
CDC		Clears all Service Codes.

DEC CED	Provides one additional digit of resolution for each measured parameter for blood and serum samples. QC and Standard samples are always displayed with high resolution. Urine samples are always displayed in low resolution.
ECO OCE	Allows the operator to run the instrument in the economy mode. The instrument will enter the **STANDBY MODE**. This occurs at the time of the next 2-point calibration when no samples have been analyzed since the last 2-point calibration.
FIF IFI	Allows printing of electrode voltages during printout of measurements and calibrations. (not available for 9140)
LEM MEL (9180/9181 only)	This service code will print the last 20 error messages with the date and time of occurrence.
MGL LGM	This service code is available only in the model 9140/ 9180/9181 analyzer and enables Ca^{++} values to be displayed in mg/dL. The normal mode displays values in mmol/L. QC and Standard results are always displayed in mmol/L.
NOB BON (9180 /9181only)	This service code disables the beep.
QCC CCQ	When this code is enabled, QC values will be reported in direct ISE measurement instead of flame-equivalent values. In this mode, correlation factors are NOT applied to the measured values.
SFC (9180/9181 only)	This code allows the input of a percentage for the ISE SnapPak™ counter.
SLC CLS (9180/9181 only)	When this code is set, the current setting of the leasing counter, which cannot be reset by the operator, is printed on the calibration report.
SSC CSS (9181 only)	This code toggles needle height to accommodate smaller sample cups. In the default setting, the analyzer works with 2.0 mL cups. To select 0.25 mL sample cups, **SSC** has to be activated. To return to the default setting, **CSS** has to be activated.

CODE	FUNCTION	9120	9130	9140	9180	9181
ALL	Enables Ca^{++} during autom. blood/serum measurement					X
CDC	Clears all Service Codes	X	X	X	X	X
DEC	Additional display resolution	X	X	X	X	X
ECO	Economy Mode	X	X	X	X	X
FIF	Cal voltages on display	X	X		X	X
LEM	Last 20 error messages printed			X	X	
MGL	Display mg/dL			X	X	X
NOB	No beep				X	X
QCC	QC values direct ISE measurement	X	X	X	X	X
SFC	SnapPak Counter input			X	X	
SLC	Set "Leasing Counter"				X	X
SSC	Small Sample Cups					X

ANALYZER RESET

Press **YES** and **NO** keys simultaneously and turn power off and back on to provide a total reset of the instrument software.
CAUTION! All QC Data and Instrument Programming will be lost.

WARM-UP BYPASS

Press **YES** and **NO** keys simultaneously during instrument warm-up.

4 Description of Modules

4.1 Mechanical Assemblies

4.1.1 Front Door Assembly

For the 9120, 30, 40 and 80 analyzers, the front door can be removed by moving the analyzer to the edge of a work surface so the analyzer door, when opened, will extend past the edge of the work surface. With one hand, hold the analyzer door near the right side hinge pin and, with the other hand, gently apply pressure to the middle rear area of the door. This will allow the right hinge pin to clear the retaining hole in the main chassis. The door can then be removed from the analyzer.
The 9181 front panel can be removed by tilting it slightly away from the analyzer and lifting it straight up. The plastic window can also be replaced in the field by gently pressing from the rear of the window and snapping the plastic window out toward the front of the analyzer door. The door magnets cannot be replaced in the field as they are glued in place with conductive adhesive.

4.1.2 Needle Unit Assembly

Both sample needle and fill port are designed for easy replacement by the user.
To remove the fill port assembly for replacement, pull the fill port holder towards the front for easy access. Then, press the two plastic tabs on the fill port to allow removal of the fill port from the fill port holder. The sample needle can also be removed and is supplied as a one-piece assembly including the intake tubing.
To remove the sample needle, grasp the needle near the white holder block and pull up to unsnap the sample needle from its position. To replace the assembly, align a replacement sample needle and press the replacement assembly into place.

Three screws located on the left side of the assembly hold the needle unit assembly in place. To access the two rear screws, turn power off and remove the rear panel. The rear panel can be moved away from the unit for easier access by unplugging the wire harness from the power supply. The SBC board can now be removed by removing the screws which secure the SBC board and disconnecting the cables on the SBC board. Disconnect the connector to the lamp board which supplies the Door Open signal. The two rear screws which secure the needle unit can now be removed using an Allen wrench. Then, remove the front securing screw, the sample intake tubing and the reagent supply tubing (red tag) from the fill port. The needle unit can now be removed from the front of the analyzer for replacement. Reference the Illustrated Parts diagram in Section 8 for a detailed parts diagram of the needle unit.

4.1.3 Electrode Holder Assembly

To remove the electrode holder assembly from the analyzer, first unplug the sample intake tubing on the right side of the module, then the sample sensor cable, then remove the reference solution tubing connector and last, take out the waste tube (green tag) at the left side of the electrode holder. The electrode holder can now be removed by pressing the two plastic tabs (right and left side of the module) and sliding the module forward. Press the plastic tabs again to release the second detent and completely remove the module from the analyzer. The sample sensor and/or the left side electrode holder can be removed and replaced by removing the screws on the under side of this module. The Illustrated Parts List in Section 8 provides a detailed reference of the parts of this assembly.

4.1.4 Peristaltic Pump Assembly

Replacement of the roller assembly of the peristaltic pump can be accomplished by removing the pump tubing and firmly pulling the roller assembly toward the front. To replace the roller assembly, align the roller and the flat on the motor shaft and press the replacement roller into position.

To remove the motor, first remove the rear panel assembly and SBC Board as described in Sections 4.1.7 and 4.1.8. Now, the electrical connector on the lamp board can be accessed to unplug the motor connector. The motor can now be removed by removing four screws located on the front of the housing near the peristaltic pump.

4.1.5 Solenoid Assembly

Removal of each solenoid is identical. Each solenoid valve has a removable pressure piece which is held in place by a solenoid cap. To remove the pressure piece, locate the arrow on the solenoid cap and remove the solenoid cap by sliding it off the solenoid shaft in the direction of the arrow. This exposes the pressure piece which can now be removed from the solenoid shaft. To replace pressure piece and cap, energize the solenoid as described in Section 3.2 (Test Valves). This extends the solenoid shaft to the outermost position for ease in replacing pressure piece and cap. Removal of the pressure piece and cap is required prior to removing the solenoid and allows for easier replacement of the tubing under each solenoid.

To remove the solenoid assembly, the rear panel and the SBC Board described in Section 4.1.8 must be removed first. Each solenoid has an electrical connection to the lamp board which must be unplugged prior to removal of the solenoid. At this point, remove the two screws on the front panel to remove the solenoid assembly.

4.1.6 Printer Assembly

The printer assembly is designed to allow for easy removal by the user which can be accomplished without removal of the electrical power to the analyzer. Slide the paper tray forward to allow access to the printer, tear the paper roll and completely remove it together with the paper tray. Slide fingers under the printer assembly and pull the printer forward. This will disengage the printer from the interconnector and enable removal of the assembly from the front of the analyzer. Removal of the printer should be performed for replacement and for removal of a paper jam.
To replace the printer, locate the printer slide and insert the printer assembly. Press firmly into place to ensure electrical connection of the printer.

Note: Never attempt to dislodge paper from the printer with a paper clip or similar object to avoid damage to the print head or printer platen.

4.1.7 Rear Panel Assembly

To remove the rear panel assembly, ensure that the power cord has been disconnected. Remove the four corner screws to expose the rear panel. The power supply module located on the rear panel assembly can now be removed by removing the three screws securing the circuit board and by disconnecting the wiring interconnections. The main power receptacle can also be replaced by removing the two screws holding this assembly.

4.1.8 SBC Board

After the rear panel (Section 4.1.7) has been removed, the SBC Board is accessible for removal. This circuit board can be removed by removing the seven screws securing the board to the housing and by disconnecting electrical connectors from the power supply module, display board and lamp board.
The electrode push pins can now be replaced by simply pulling the connecting pin from its socket. When installing the board, make sure to place the plastic washers under the screw heads.

4.1.9 Lamp Board

The rear panel and SBC board must be removed to gain access to the lamp board. Remove one screw and washer which hold the board in place and remove the electrical connectors to remove this board.

4.1.10 Display Board

The rear panel and SBC board must be removed to gain access to the display board. Remove three screws and 50 degree spacers and unplug the sample sensor cable from the front and the ribbon cable to the SBC board to remove the display board.

4.2 Fluidic Module

4.2.1 Standard A

Standard A is drawn to the electrode module by vacuum provided by the peristaltic pump. When Standard A is to be aspirated into the electrode module, solenoid valve A is opened and solenoid valves B, V and R are closed. Standard A is then drawn from the ISE SnapPak™, to the fill port, through the sample needle and is sensed by the sample sensor. At this point, solenoid valve V is opened and solenoid valve A is closed as the peristaltic pump continues to pump Standard A into the electrode module. As the trailing edge of the Standard A sample is sensed by the sample sensor, the peristaltic pump stops. During the time Standard A is aspirated into the electrode module, the reference housing is pressurized due to the peristaltic pump providing pressure to the reference solution line and solenoid valve R being closed. An amount of reference solution is forced out through the reference junction to provide contact to the sample.

4.2.2 Standard B/C

The process for Standard B/C is identical to that of Standard A with the exception of the operation of solenoid valves B and C. These solenoid valves are operated in reverse order of Standard A aspiration.

4.2.3 Reference Solution

The reference housing is filled automatically using the second winding of the peristaltic pump and solenoid valve R. The reference solution connector allows for the reference housing tubing to be plugged into the reference solution circuit. As the peristaltic pump aspirates reference solution, solenoid valve R is opened to allow excess solution to be pumped into the reference return line of the ISE SnapPak™.

4.2.4 Waste Liquids

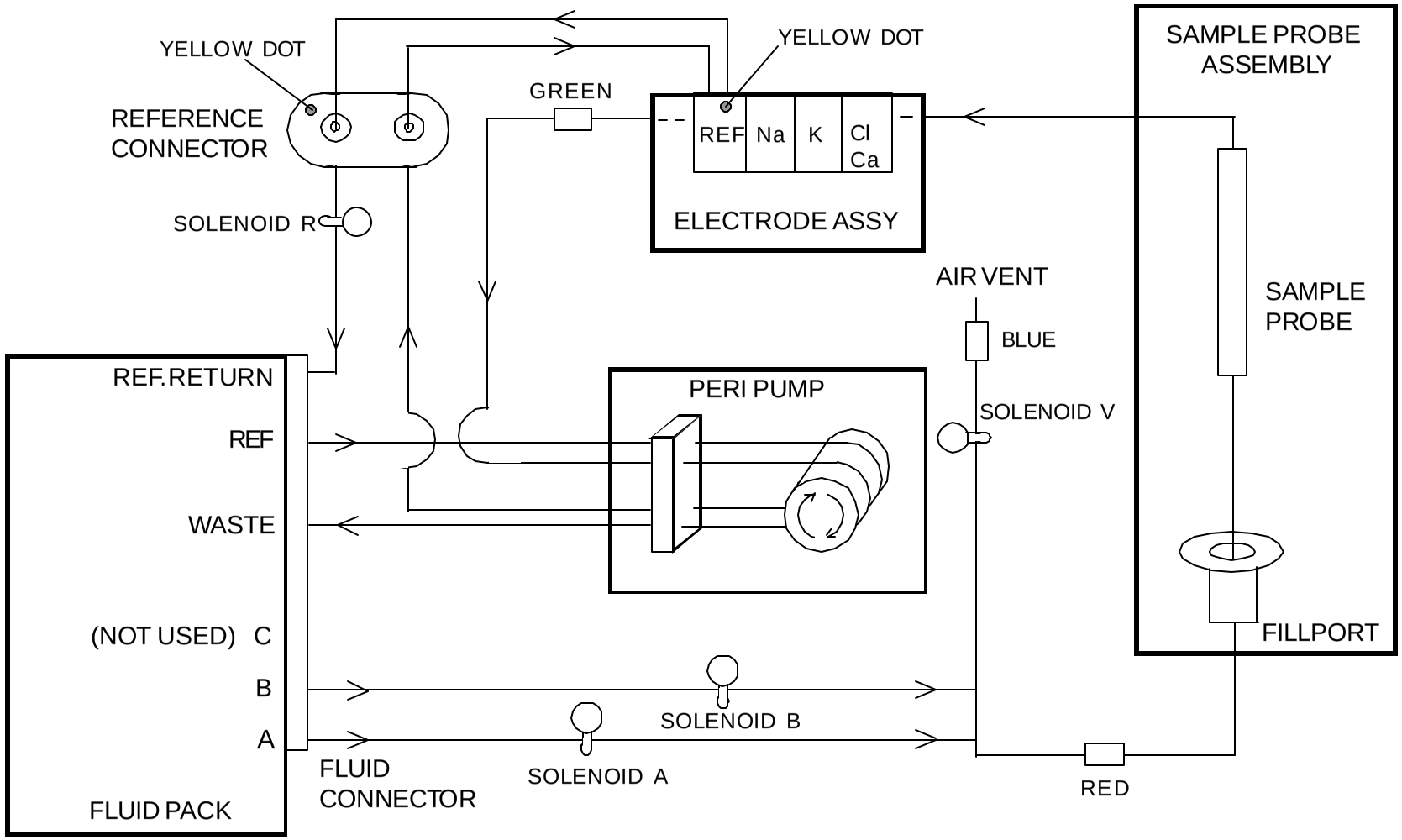
Calibration standard and sample waste are pumped out of the left side of the electrode module (green-banded tubing) through the peristaltic pump to the waste line of the ISE SnapPak™. An internal one-way valve is incorporated into the waste line of each ISE SnapPak™ to prevent any waste products from leaking out of the ISE SnapPak™.

4.2.5 Main Tube Set

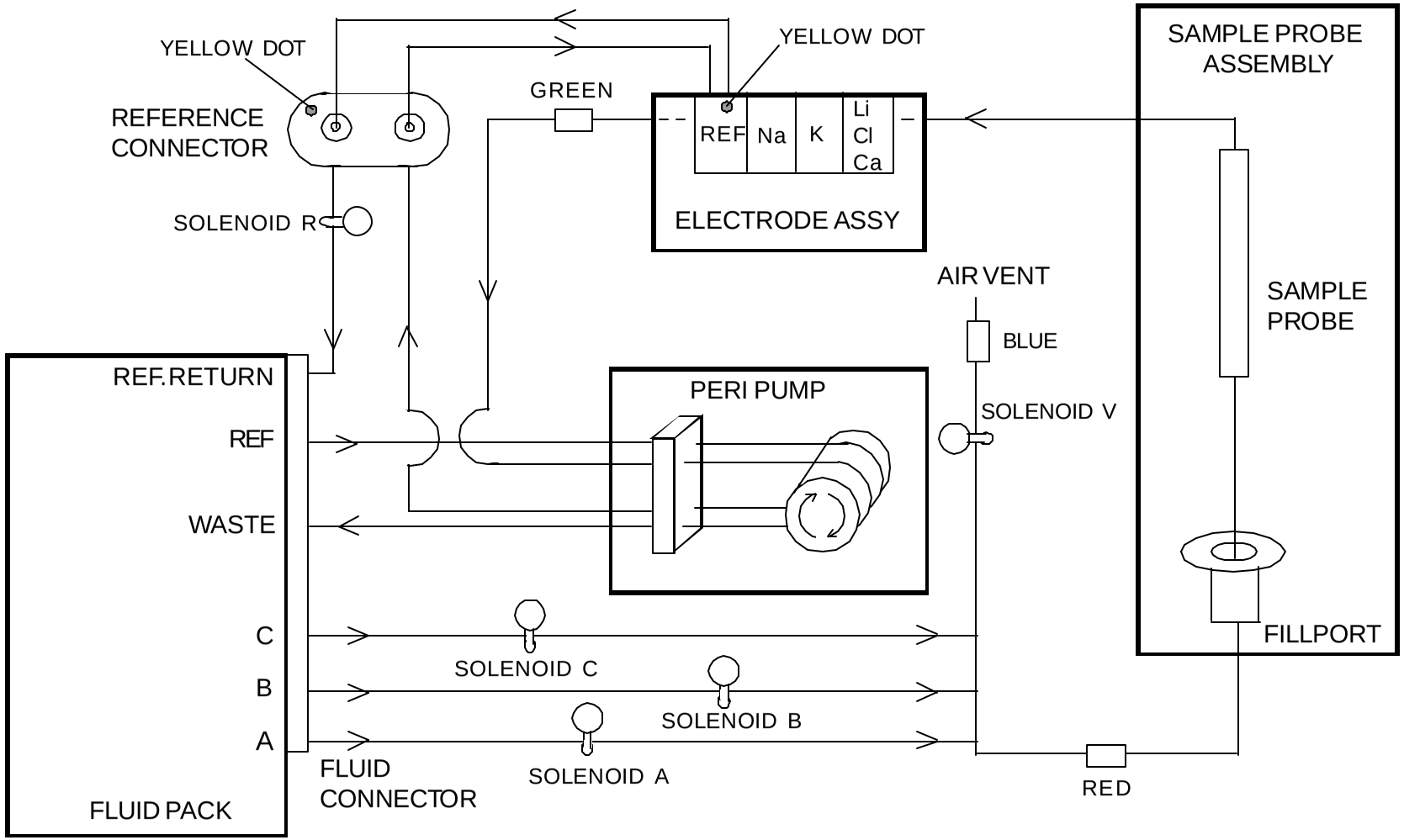
The main tube set is supplied as a pre-cut tubing harness with the fluidic interconnections preassembled. Replacement of the tube set should be performed annually. For removal of the tubing, first remove the ISE SnapPak™ from the reagent compartment. This will allow access for removal of the white TPR block which is the main interconnection between the ISE SnapPak™ and the tubing. This block can be removed by grasping the front surface and pulling forward. Next, remove tubing from each solenoid valve. Follow the procedure outlined in Section 4.1.5 for disassembly of the solenoid valves to enable fluidic tubing to be easily removed at each solenoid. Pull the two pump windings at the peristaltic pump tube set off the pump roller and remove the white reference solution tube connector. Remove the white TPR reference solution block by grasping the front of the block and pulling forward. The three tube connections are labeled with green, blue and red tags. All remaining tubes can now be removed and the entire tubing harness can be discarded.

Fit the replacement tubing harness and assemble in reverse order as disassembly. Reference the Tube Diagram on the next page for correct tube locations.

AVL 9120, 9130, 9140 FLUIDIC DIAGRAM



AVL 9180/9181 FLUIDIC DIAGRAM



4.3 Electronics

4.3.1 ISE SBC Card

Power Circuits

Power is supplied to this circuit board through connector JP3 from the power supply assembly. Test points are provided to measure supply voltages, and light emitting diodes D1 through D5 are turned on to indicate each supply voltage present on the card. Since each LED is connected in series after the fuse, a blown fuse results in the respective LED turned off.

Four additional voltage regulator circuits are mounted on the ISE SBC II Card. IC U2 and IC U3 provide -8 VDC and +8 VDC (9180/9181: -5 VDC and +5 VDC) and are used to provide the supply voltages for the analog circuitry. IC U1 develops the supply voltage used to operate the peristaltic pump and provide either +10 VDC or +22 VDC. The +22 VDC is supplied only for the FAST speed and +10 VDC is used for all other pump speeds. Signal FAST/SLOW determines which supply voltage is selected.

U5 switches the voltage between 22VDC and 12.5 VDC which supplies the solenoids. When a solenoid is turned on, the voltage switches to 22VDC for 0.5 sec, then it returns to 12.5 VDC.

The circuit which includes Q7 and R5 provides necessary switching for the measuring chamber illuminator LED's.

The following list identifies the test points, fuses and LED's for each respective DC supply voltage:

Test Point	Voltage	Fuse	Rating	LED
TP1	+24 VDC	F3		D3
TP2	+5 VDC	F1/F2		D1/D2
TP3	-12 VDC	F4		D4
TP4	+12 VDC	F5		D5
TP5	Ground			
TP6	-8 VDC (9180/9181: -5 VDC)			
TP7	+22/12 VDC			
TP8	+8 VDC (9180/9181: +5 VDC)			
TP9	Na^+ Channel			
TP10	K^+ Channel			
TP11	Ca^{++}/Cl^- Channel (Li^+ 9180/9181 only)			
TP12	Temperature			
TP13	+10.000 V Ref. Voltage			
TP14	-2.500 VRef. Voltage			
TP15	Sample Sensor			
TP16	+22/12.5VDC			

Valve Drivers

The solenoids are activated by transistors Q9 - Q13. To open the solenoid, a 0.5-second pulse of 22 volts is applied, then the voltage drops down to 12.5 volts to hold the solenoid open.

Pump Motor Driver/Cover Sensor

The pump driver circuit IC U9 and IC U10 provide the drive and control for the peristaltic pump. Signals PUMPEN, Pump Enable and PUMPSTEP, Pump Step Pulses enable IC U10 to provide the necessary control to driver IC U9 which supplies pump drive signals PHASE A through PHASE D to control peristaltic pump operation.

IC U11 operates with signal DCLOSED from the sample door light gate to provide signal DOOR which detects the status of the sample door (open or closed).

Input Amplifiers

IC U13, U14 and U15 (9180/9181: U13 only) provide high to low input impedance matching for each Electrode input. Offset generator IC U12D and amplifiers IC U12A, U12B and U12C provide the necessary gain and offset for each electrode channel. TP9, TP10 and TP11 provide test points for the Na^{+}, K^{+} and Cl/Ca^{++}/Li channels respectively.

Temperature Sensor

This is an optional circuit which is used in the 9140, 9180 and 9181.
The circuit creates a temperature-dependent voltage which is converted by software to degrees C. R54 can be adjusted for correct temperature setting.

Analog Channel Selector and A/D Converter

Analog inputs from the input amplifiers are selected via signals ADSEL0 through ADSEL2 and are multiplexed by IC U19. This multiplexed signal is then fed to the A/D Converter IC U20. IC U21 supplies the necessary reference voltage (2500mV) for the A/D Converter and can be measured at TP14.

Microprocessor

Microprocessor IC U31, EPROM IC U25 (9180/9181: U40) and MOSTEK Real Time Clock/RAM IC U22 form the components of the central processing system. IC U23 Address Demultiplexer, IC U24 Programmable Array Logic (PAL) and IC U28 provide serial data buses (9180/9181: U23, U24 and U28 not present). IC U34 through IC U38 convert serial data to parallel data and provide printer data, display data, solenoid valve control and peristaltic pump control. This fashion of serial to parallel data conversion is used to prevent analyzer lock-up by peripheral devices. The RS232 serial interface is a direct input/output from the microprocessor utilizing interface driver and receiver U29 and U30.

SnapPak Sensor (9180/9181 only)

Optical detector ISO1 provides a signal indicating if the ISE SnapPak™ is in place. This signal is fed to U41 which converts the light gate input to a digital logic output indicating SnapPak position (IN or OUT).

4.3.2 Lamp Board

The lamp board contains the LED array used to illuminate the measuring chamber and the interconnectors used for all solenoids, the peristaltic pump, door sensor and sample turntable (9181 only). A ribbon cable from the SBC Board supplies the electrical connection for each signal through connector JP6.

4.3.3 Display Board

The display board contains the LCD display, sample sensor connector and the **YES** and **NO** switches used for operation of the analyzer. Power and signal interconnection is accomplished via a ribbon cable from the SBC board through JP2 on the display board.

Display boards utilized in the 9181 analyzer also contain circuitry for both the needle mechanism motor control and position sensor. The autosampler "Table Present" signal is also buffered through U1 on this board.

5 Maintenance and Troubleshooting

Maintenance procedures for the 9120, 30, 40, 80, 81 Analyzers require minimal time by the operator to perform. The procedures outlined below should be performed by the schedule indicated. Detailed instructions for these procedures can be found in the Operator's Manual describing the correct method to perform routine analyzer maintenance.

5.1 Maintenance

Daily Maintenance

- Perform cleaning cycle.

- Perform conditioning cycle.

Weekly Maintenance

- Clean sample probe and fill port.

- Clean analyzer surfaces.

Monthly Maintenance

- Clean reference electrode housing.

Six Month Maintenance

- Replace peristaltic pump tubing.

Annual Preventive Maintenance

- Replace complete tubing set.

- Replace peristaltic pump tubing.

- Replace fill port assembly.

- Replace sample probe.

- Replace sample sensor Quad-ring.

- Check sample sensor voltage.

- Check sample temperature (9140/80/81 only).

5.2 Error Messages and Troubleshooting

STATUS: NOT CALIBRATED

This message is only displayed when a calibration has been interrupted by pressing **NO** or opening the sample door. Perform a calibration to return to the **READY** Mode.

STANDARD A NOT DETECTED

This message is displayed when the sample sensor is unable to properly detect the Standard A solution in a programmed time period. As the analyzer draws a sample of Standard A, the leading edge of the solution is detected by the sample sensor. The sample sensor must also detect a continuous flow of Standard A Solution into the sample chamber, lasting several seconds, without encountering air bubbles or air. After several seconds, the trailing edge of the Standard A sample is sensed, the peristaltic pump stops and measurement occurs.

Possible causes and remedies:

- Check for air leaks preventing the Standard from being drawn into the chamber. Ensure that all O-rings are in place. There must be a continuous draw of standard solution, free of air bubbles.
  Check solenoid V for proper sealing of the vent line.
  Check fill port to ensure the absence of air leaks.

- Check for clots or crystals formed in the Standard A tubing or electrode chamber.

- Ensure that the sample sensor is plugged in securely and perform Sample Sensor Test to ensure sensor is operating correctly. Clean, adjust or replace sample sensor to correct sample sensor operation.

- Replace peristaltic pump tube set to ensure proper sample aspiration.

- Check the fluid remaining in the ISE SnapPak™. If less than 5% remains, replace the ISE SnapPak™.

STANDARD B NOT DETECTED
STANDARD C NOT DETECTED (9180/9181 only)

The system for drawing Standard B or C is like that of Standard A. If Standard A is drawn properly and Standard B or C is not detected, check Standard B tubing for crystallization. Perform checks for Standard A detection problems to correct. During the calibration sequence, Standard B or C is drawn into the measuring chamber prior to Standard A, therefore check if Standard A calibrant can be properly detected to isolate possible fluidic faults. If neither Standard A, B nor C are detected check for air leaks or blockages within the fluidic path.

CHECK SAMPLE SENSOR

The sample sensor must provide a reading of 80 - 120 when air is detected. Perform Test Sample Sensor to observe sample sensor response. When clear fluid (e.g. water) is aspirated, the sample sensor display must indicate an increase of of at least 40 units. For blood samples (not transparent), the reading should decrease by at least 40 units. The sample sensor is calibrated with air during each calibration. Perform a calibration to remove the error message after troubleshooting.

Possible causes and remedies:

- Clean sample sensor using Daily Cleaning procedure.
- Check for correct drying of measuring chamber during the wash cycle.
- Replace peristaltic pump tube set.
- Test and adjust sample sensor to correct adjustment.
- Replace sample sensor assembly.

CHECK REFERENCE HOUSING

At the beginning of a calibration, pressure is formed in the reference housing while the R valve is closed and the V valve is open. After Standard A is detected in the sample chamber, the back pressure formed in the reference housing causes the Standard A solution to move back toward the sample sensor. When the standard A solution is detected by the sample sensor, the R valve is opened to release the pressure. If the sample sensor does not detect standard A as it moves back, **CHECK REFERENCE HOUSING** will be displayed.

Possible causes and remedies:

- Check for clogged reference housing and clean per monthly maintenance procedures.
- Check and ensure that reference tubing is securely connected at the tubing connector.
- Check for proper filling of the reference housing and ensure that reference solution reagent level allows complete filling of the reference housing.
- Check for bubble-free aspiration of Standard A.

PLEASE CLOSE SAMPLE DOOR (except 9181)

This message occurs and prints **NO SAMPLE** on the print-out, when either of two conditions exists.

1. Sample door is not closed within 20 seconds after samples are in place.
2. Sample door has been opened and no sample is detected within 20 seconds.

Possible causes and remedies:

- Close sample door within the time allowed.
- Check needle mechanism light gate.
- Check whether sample sensor is plugged in.

NO SAMPLE

This message is displayed when any of the following conditions occur:

1. During sampling, either a bubble in the sample is detected or the sample size is smaller than the minimum sample required.

2. The sample door is opened and no sample is fed into the analyzer.

3. Sample door is not closed within 20 seconds after sample is detected.

Possible causes and remedies:

- Check whether the sample sensor is plugged in and perform **TEST SAMPLE SENSOR** to verify that it operates correctly.

- Check sample draw and look for clots or leaks in the sampling system.

CLEANING FLUID NOT DETECTED

When the cleaning cycle has been initiated, the analyzer checks for proper aspiration of the cleaning solution using the sample sensor. If solution is not detected in the proper time, above error message will be displayed.

Possible causes and remedies:

- Ensure that a sufficient volume of cleaning solution is presented for aspiration and no air bubbles are present as solution is aspirated.

- Check to ensure that the solution is being aspirated through the sampling mechanism correctly. The sample path must be free of leaks or clots.

- Verify that sample sensor is properly plugged in and perform the **SAMPLE SENSOR TEST** to verify the correct operation of the sample sensor.

- Check pump tubing and replace as necessary to ensure a correct pump rate.

CONDITIONING FLUID NOT DETECTED

When the conditioning cycle has been initiated, the analyzer checks for proper aspiration of the conditioning solution using the sample sensor. If the solution is not detected in the proper time, this error message will be displayed.

Possible causes and remedies:

- Ensure that a sufficient volume of conditioning solution is presented for aspiration and no air bubbles are present as solution is aspirated.
- Check to ensure that the solution is being properly aspirated through the sampling mechanism. The sample path must be free of leaks or clots.
- Verify that sample sensor is correctly plugged in and perform the **SAMPLE SENSOR TEST** to verify its proper operation.
- Check pump tubing and replace as necessary to ensure correct pump rate.

INTERFACE ERROR

This message is displayed only during the **INTERFACE TEST**. Pins 2 and 3 must be shorted together to perform the **INTERFACE TEST**. Make sure that the pins are not shorted to chassis ground.

Possible cause and remedy:

- Replace SBC Card.

PAPER JAM OR PRINTER DEFECT

This message is displayed when the printer head is jammed and tries to print. It is a temporary message that is displayed for 2 seconds and then sample results are displayed. To clear paper jam remove printer from the analyzer and remove jammed paper. Replace printer and retry. The printer can be removed by grasping the rear edge of the printer assembly and pulling it to the front. The printer can be removed with the Analyzer power on. To free up jammed paper, turn the small gears on the left side of the printer module.

CHECK ELECTRODES

This message is displayed when either of the following conditions are present.

1. More than six aspirations of Standard A are required for all electrode channels.
2. The difference between voltage A and B is out of specification for all channels.

Possible causes and remedies:

- Electrodes are not plugged in. Check the slide mechanism to ensure it is in the correct position and firmly pushed into electrode connectors.
- Perform Daily Maintenance.
- Check or replace reference electrode.
- Replace ISE SnapPak™.

NA NOT CAL'D
K NOT CAL'D
CL NOT CAL'D
CA NOT CAL'D
LI NOT CAL'D

These messages will be displayed when a specific electrode does not calibrate properly during a calibration sequence. If more than six standard draws are required or the difference between Standard A and Standard B voltages is out of range, the **NOT CALIBRATED** message will be displayed for each channel which exhibits either of these conditions. A copy of the calibration report should be printed to provide the electrode output voltages measured during calibration. The electrode voltage range table identifies correct voltage ranges for each electrode parameter.
If the difference between Standard A and Standard C (9180/9181 only) is out of range for Li^+ or Na^+, **LI NOT CAL'D** will be displayed.
Possible causes and remedies:

- Check to ensure calibration reagents are transported correctly. Test for leaks, blockages, bubbles, or improper pump flow rate.
- Check or replace ISE SnapPak™.
- Check whether electrodes are plugged in properly. Check the slide mechanism to ensure it is in the correct position and firmly pushed into electrode connectors. Clean and/or replace electrode.
- If A-C is out of range for Na^+, repeat the calibration or replace the ISE SnapPak™.
- Check or replace SBC Card.

ELECTRODE VOLTAGE RANGES 9120, 30, 40

Electrode	*Standard A*	*Standard B*	*Allowable Difference A - B*	
			(9120/9130)	*(9140)*
Na^+	-600 to +2400	-1600 to +2200	+720 to +2000	+250 to +680
K^+	-700 to +1000	-2500 to +500	+520 to +1800	+470 to +1200
Cl^-	-3100 to -100	-1100 to +1800	-520 to -1200	not used
Ca^{++}	-2600 to +1400	-2100 to +2700	not used	-480 to -900

ELECTRODE VOLTAGE RANGES 9180, 81

Electrode	*Standard A*	*Standard B*	*Standard C*	*Allowable Difference*	
				A-B	*A-C*
Na^+	-600 to +2400	-1600 to +2000	-600 to +2400	+250 to +680	-50 to +50
K^+	-700 to +1000	-2500 to +500	-700 to +1000	+470 to +1200	-40 to +40
Cl^-	-3100 to -100	-1000 to +3000	-3100 to -100	-370 to -860	not used
Ca^{++}	-3100 to +1000	-2300 to +2500	-3100 to +1000	-350 to -660	-150 to +150
Li^+	-3100 to +1900	-3600 to +1400	-2600 to +3400	+1 to +760	-1730 to -285

CLOG CHECK FLUID PATH

After completion of sample measurement or calibration, the analyzer will monitor the sample sensor to determine if the sample path has been cleared. This message will be displayed if the sample path has not been cleared.

Possible causes and remedies:

- Check for blockages in the sample path, especially in the sample probe, the tubing to the sample sensor and in the sample sensor.
- Check sample sensor is securely plugged in and check sample sensor test to ensure correct operation.
- Check peristaltic pump and tubing are correct and all tubing is properly in place.

———
- - - -

In case the analyzer displays arrows up or arrows down instead of sample results, the concentration of the sample is outside of the measurement range.

Possible causes and remedies:

- If the sample is a urine sample, arrows up instead of the K result indicate that further dilution of the specimen is required.
- Check for proper sample preparation.
- Ensure that the sample is correctly aspirated into the measuring chamber and ensure small air bubbles are not present.
- Check for proper aspiration of Standard A.

On the 9140, 9180 and 9181 models, the calibration report will print an arrow up or down instead of the actual temperature, if the temperature measured is out of range (10.0°C -40.0°C). The temperature sensor is located in the right side electrode holder.

Possible causes and remedies:

- Ensure that sample sensor cable is securely plugged in.
- Check whether room temperature is within specified limits (15°C to 32°C / 60°F to 90°F).
- Perform temperature adjustment procedure.
- Replace SBC board or right side electrode holder.

ERR

The analyzer will display **ERR** in place of sample results when the analyzer is unable to obtain valid voltage readings from the electrode (A/D over- or under-flow).

Possible causes and remedies:

- Ensure that the electrodes are securely in place and plugged into the analyzer.
- Check to ensure proper filling of the reference electrode has occurred.
- Ensure proper sampling and proper sample preparation. Check for air bubbles in the sample.

PERFORM DAILY MAINTENANCE

This message will be printed at the end of a sample report when cleaning or conditioning have not been performed within the last 24 hours. This message is printed only. Perform Daily Maintenance to clear this message.

REPLACE FLUID PACK

When the monitored fluid level in the ISE SnapPak™ reaches 5% remaining, the analyzer will print **REPLACE FLUID PACK** at the end of each sample report. This message is printed only. Replace the ISE SnapPak™ following the instructions outlined in the Operator Manual.
To maximize the life of the ISE SnapPak™, continue running the analyzer until a **STANDARD A NOT DETECTED** message is displayed. This will ensure that the ISE SnapPak™ is completely depleted before replacement.

CHECK TEMPERATURE (9140/9180/9181 only)

On the 9140/80/81 models, the analyzer will display **CHECK TEMPERATURE** at the end of each measurement, if the temperature measured is out of range (10.0°C to 40°C). The temperature sensor is located in the right side electrode holder.

Possible causes and remedies:

- Ensure that the sample sensor cable is securely plugged in.
- Check whether room temperature is within specified limits (15°C to 32°C / 60°F to 90°F).
- Perform temperature adjustment procedure.
- Replace SBC board or right side electrode holder.

VALVE OVERTEMP! CHECK VALVES

In case one of the valve solenoids overheats, the message **VALVE OVERTEMP! CHECK VALVES** will be displayed. Each solenoid incorporates a thermo-fuse, which will reset automatically.

Possible causes and remedies:

- Turn power off for at least one hour.
- Check fuse F3 (24V).
- Check whether room temperature is within specified limits (15°C to 32°C / 60°F to 90°F).

ERROR: UPPER NEEDLE SENSOR

If probe movement to the upper position is not detected within a certain time period, the above message is displayed.

Possible remedies:

- Check for foreign material that may prevent the probe from moving freely.
- Contact AVL for technical assistance.

ERROR: LOWER NEEDLE SENSOR

If probe movement to the lower position is not detected within a certain time period, the above message is displayed.

Possible remedies:

- Make sure the fill port is installed correctly.
- Check for foreign material that may prevent the probe from moving freely.
- Contact AVL for technical assistance.

WHEEL MISSING OR SAMPLER DEFECT

During the homing sequence, the sampler checks for the sample wheel to be present.

Possible remedies:

- Make sure the wheel is present and seated correctly.
- Replace sample wheel.
- Replace sampler.

SAMPLER JAMMED OR DEFECTIVE

The analyzer checks for correct movement of the sample wheel. If the sample wheel does not move at the expected speed, the above error message is displayed.

Possible remedies:

- Check for obstructions preventing the sample wheel from moving freely.
- Replace sampler.

6 Adjustments

The 9120, 30, 40, 80 and 81 Analyzers have been designed to require minimal electronic adjustment. The sample sensor circuit may require adjustment following a change of the sample sensor or during routine troubleshooting. The temperature adjustment is active only for models 9140/9180/9181 and requires the temperature adjustment test plug for correct calibration of the temperature circuit.

6.1 Sample Sensor Adjustment

Select **TEST SAMPLE SENSOR** in the **SERVICE FUNCTIONS** menu which will display the current sample sensor setting. Adjust R93 Sample Sensor Adjust located at the top of the ISE SBC card to a value of 100. Press **YES** to turn on peristaltic pump and ensure displayed value remains constant.

Raise sample door and aspirate clear fluid (e.g. water). Displayed reading should now be 150 or greater.

Note: R93 can be accessed through the rear cover vent slot and is located at the top center on the circuit card.

6.2 Temperature Adjustment (9140/9180/9181 only)

Select **AMPLIFIER TEST** in the **SERVICE FUNCTIONS** menu which will display the current amplifier voltages. Press **NO** twice to display the temperature voltage and actual temperature display. Unplug the sample sensor and fit the Temperature Adjustment Test Plug in place of the sample sensor plug. Adjust R54 located on the SBC Board for a display of 3000mV. Unplug the Temperature Adjustment Test Plug and fit the sample sensor connector to display the actual temperature of the measuring chamber.

Due to the elevated temperature inside the analyzer, it is normal for the displayed temperature to be several degrees C higher than the actual room temperature.

If no Temperature Adjustment Test Plug is available, place a quality thermometer (preferably mercury) next to the right side electrode holder. With the front door open, wait approx. 10 min. Then adjust the displayed temperature to match the reading on the thermometer.

7 Electronic Diagrams

AVL 9120, 30, 40, 80 Analyzers

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System Block Diagram 9181 75
System Interconnect 9120, 30, 40 76
SBC PCB - Power Supply 9120, 30, 40 77
SBC PCB - Valve Drivers 9120, 30, 40 78
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SBC PCB - Temperature Circuit 9120, 30, 40 81
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System Interconnect 9180/9181 88
SBC PCB - Power Supply 9180/9181 89
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Lamp PCB 9180/9181 98
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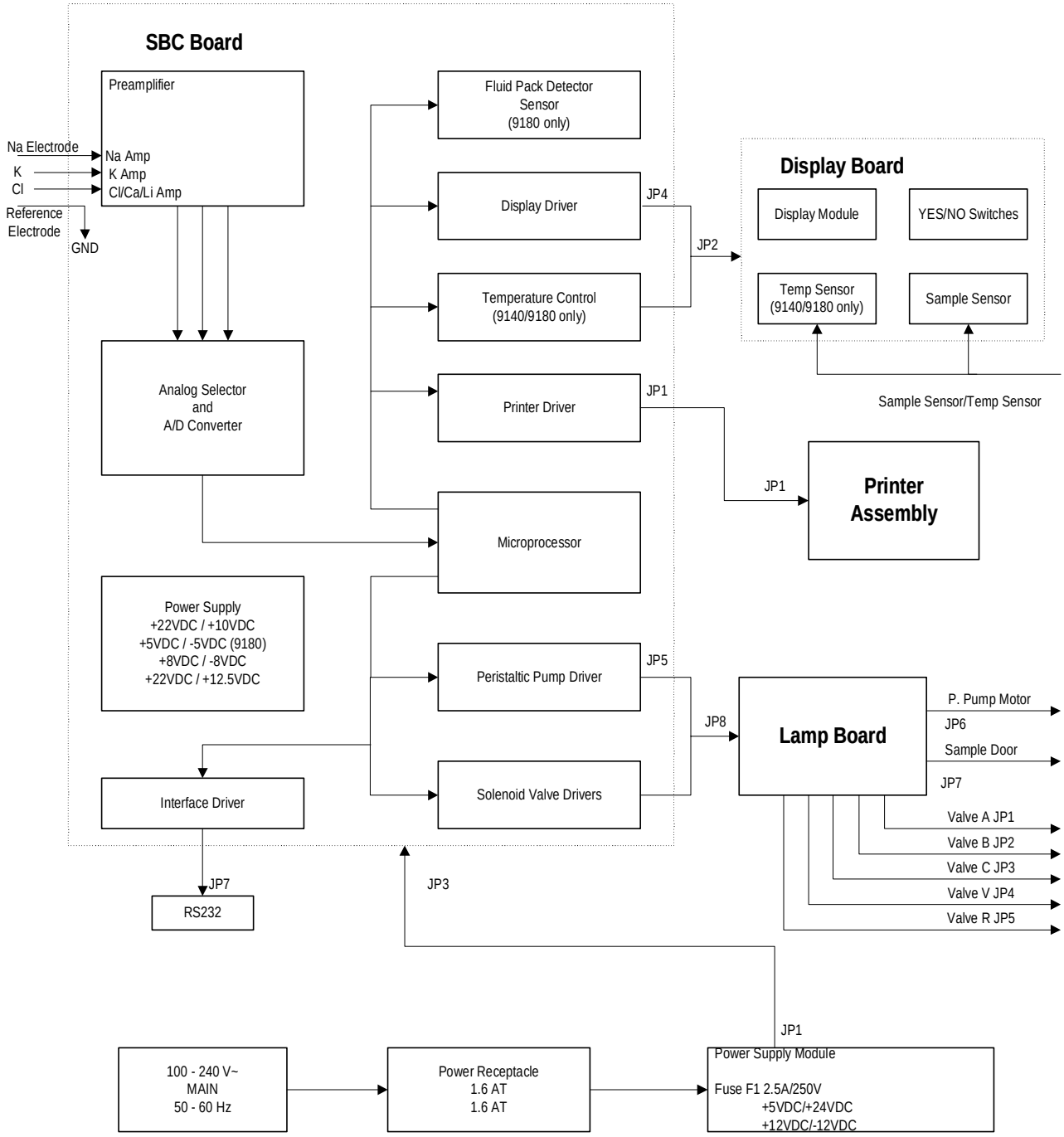
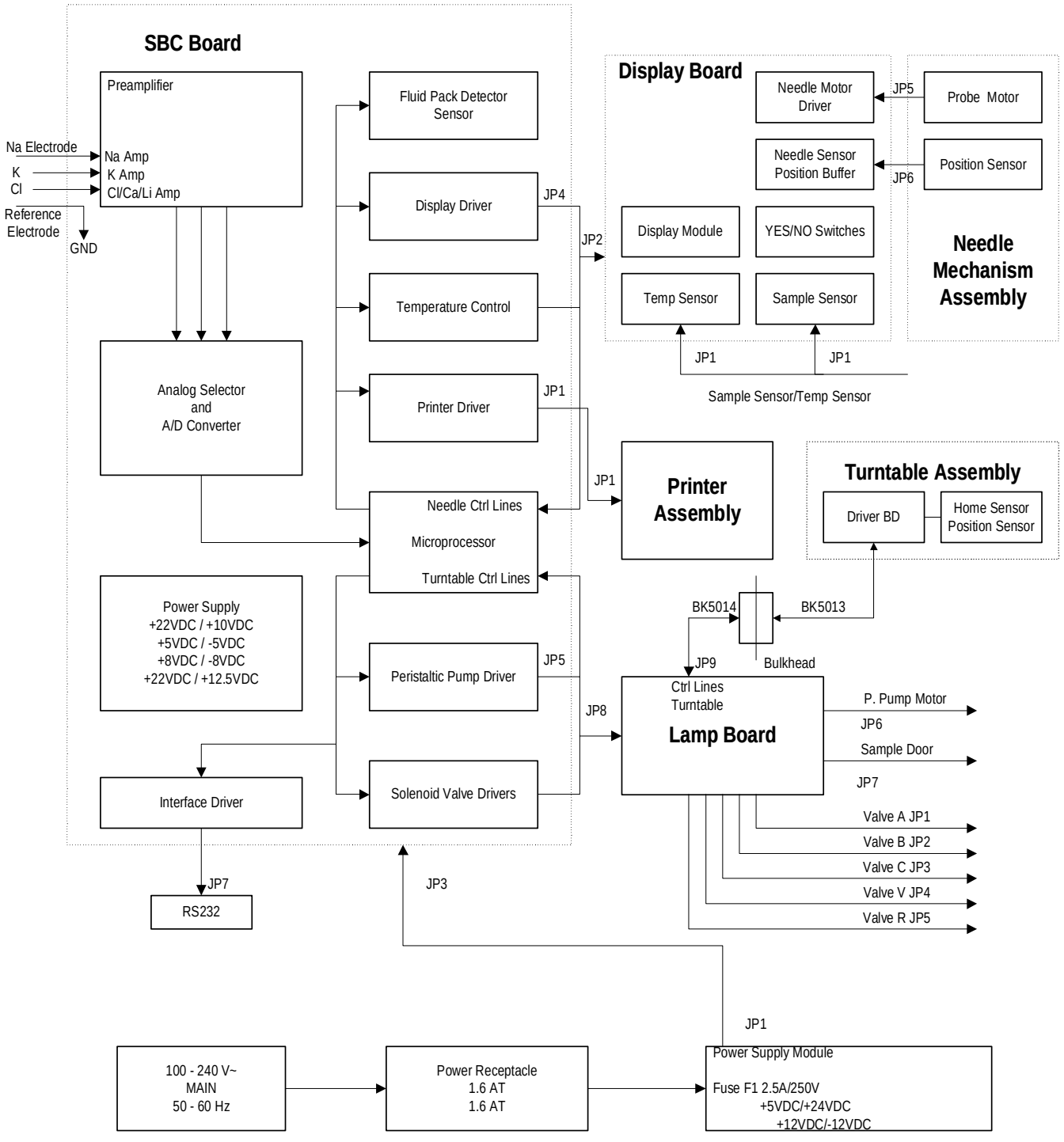
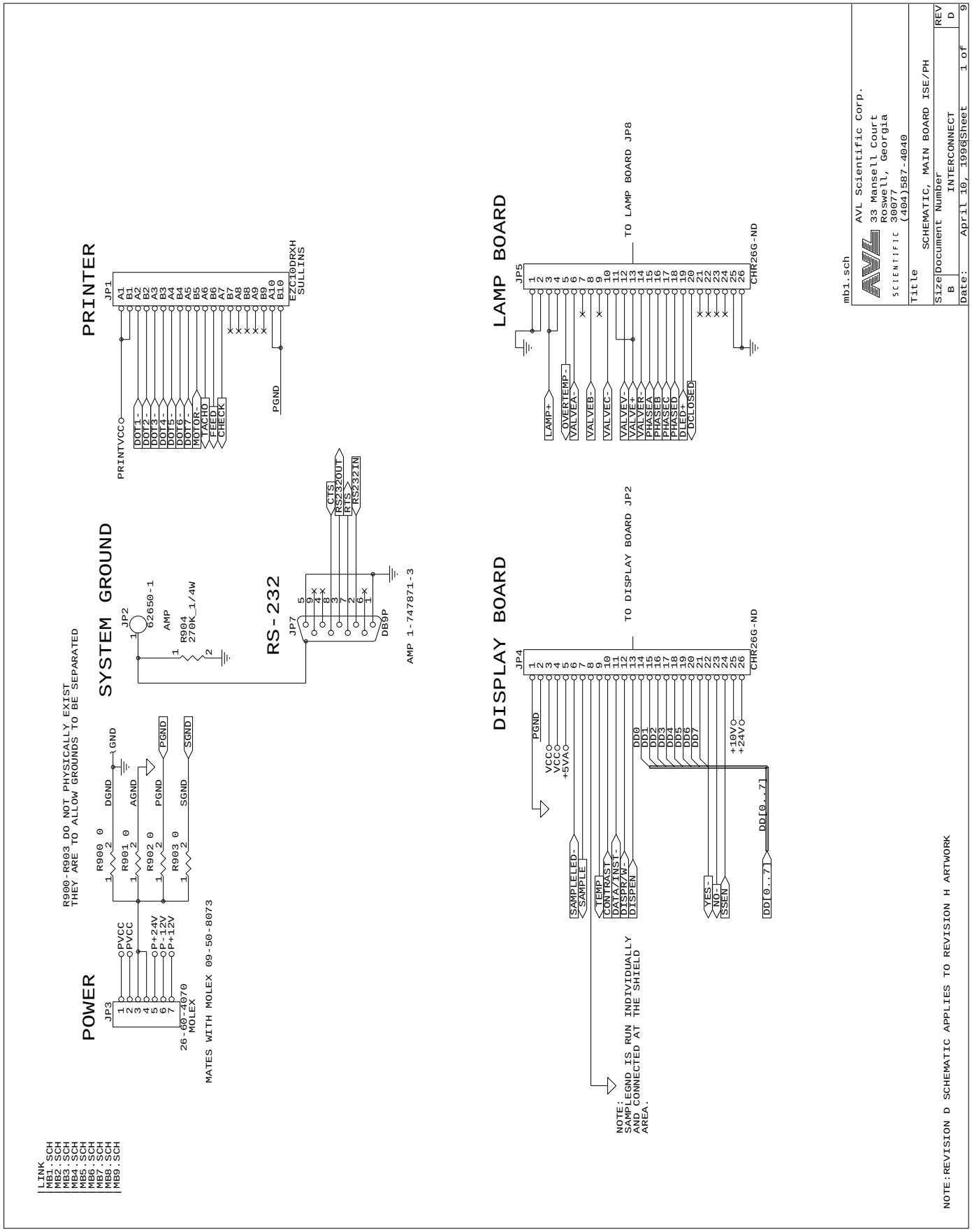
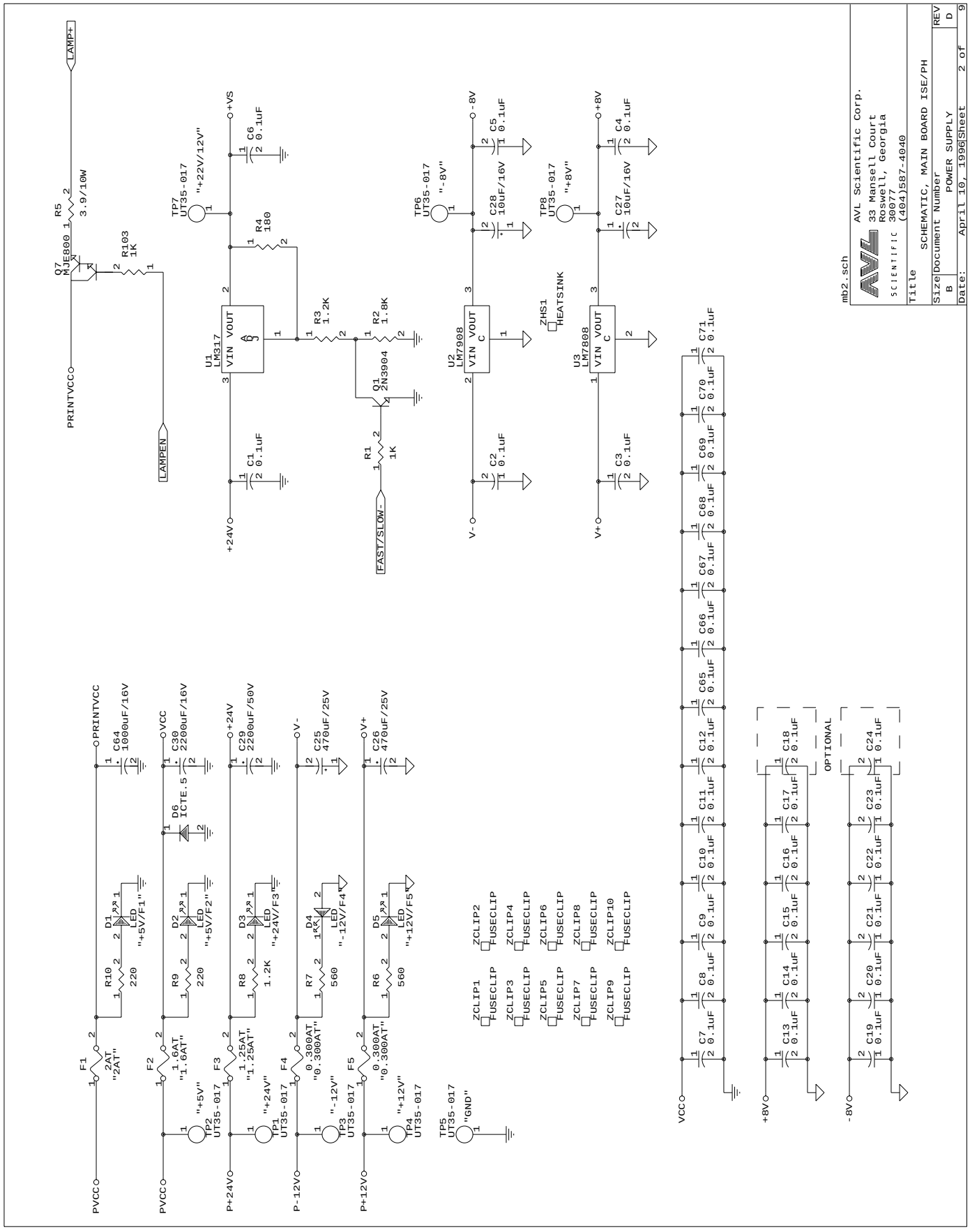
9120, 30, 40, 80 Analyzer Block Diagram

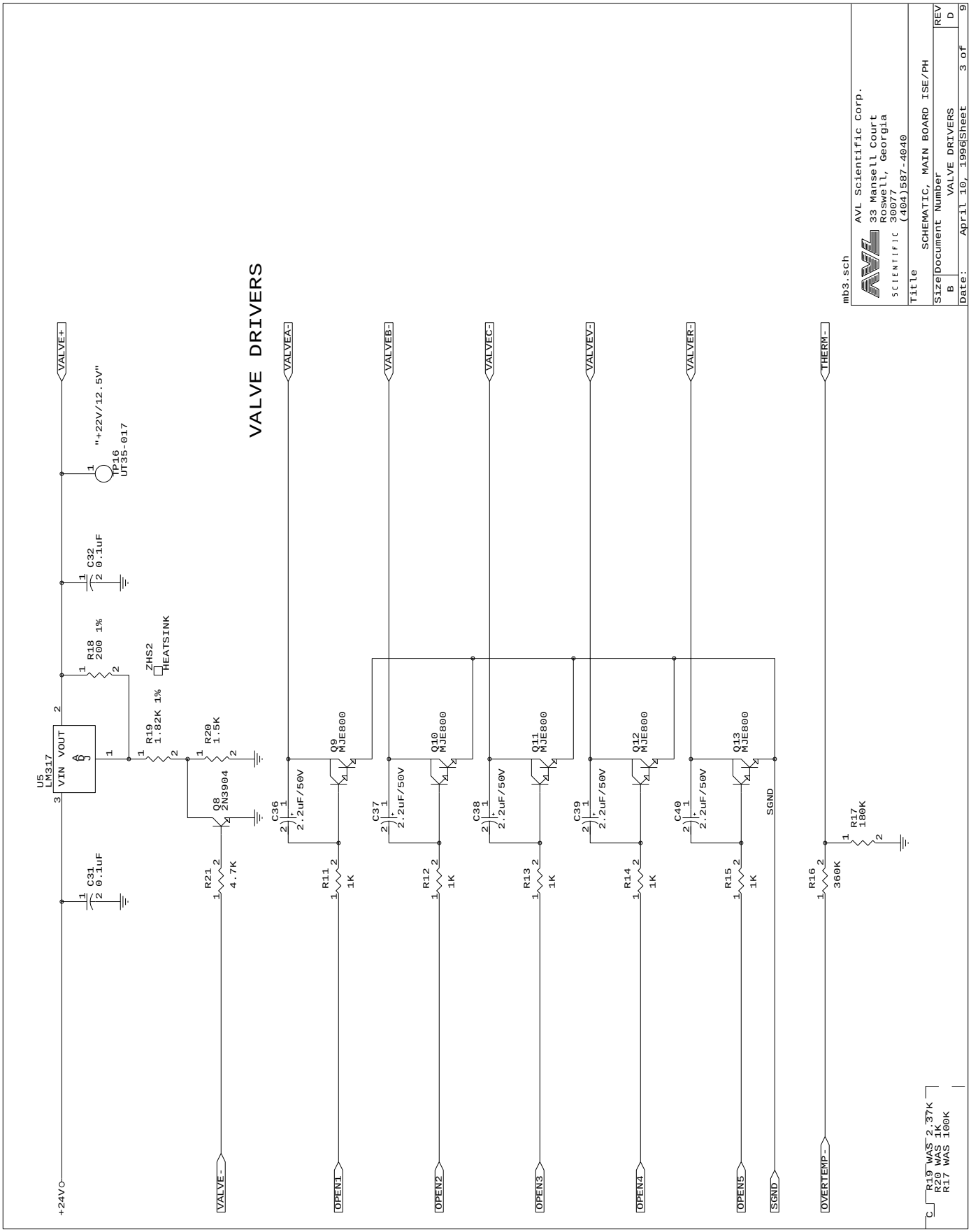


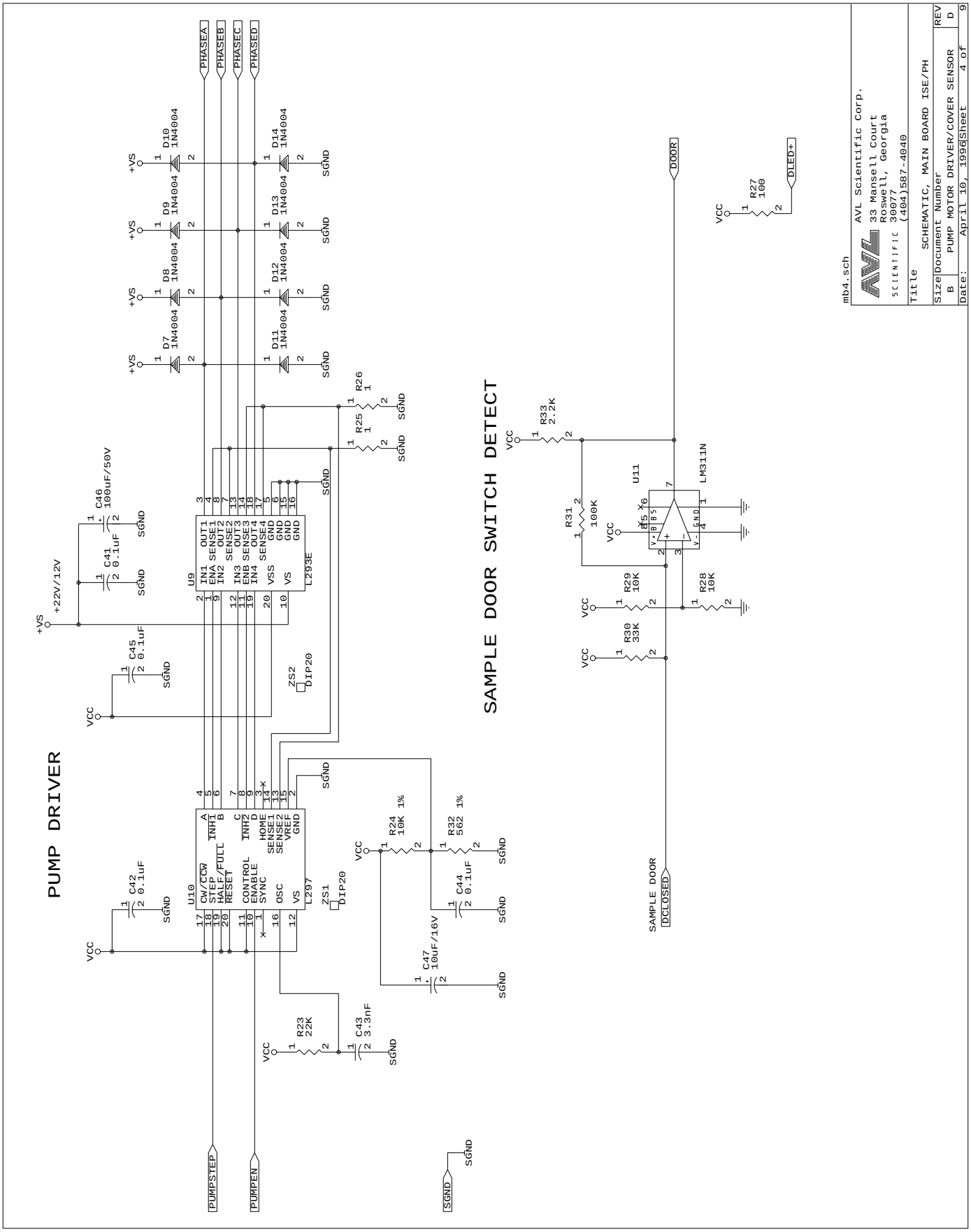
9181 Analyzer Block Diagram

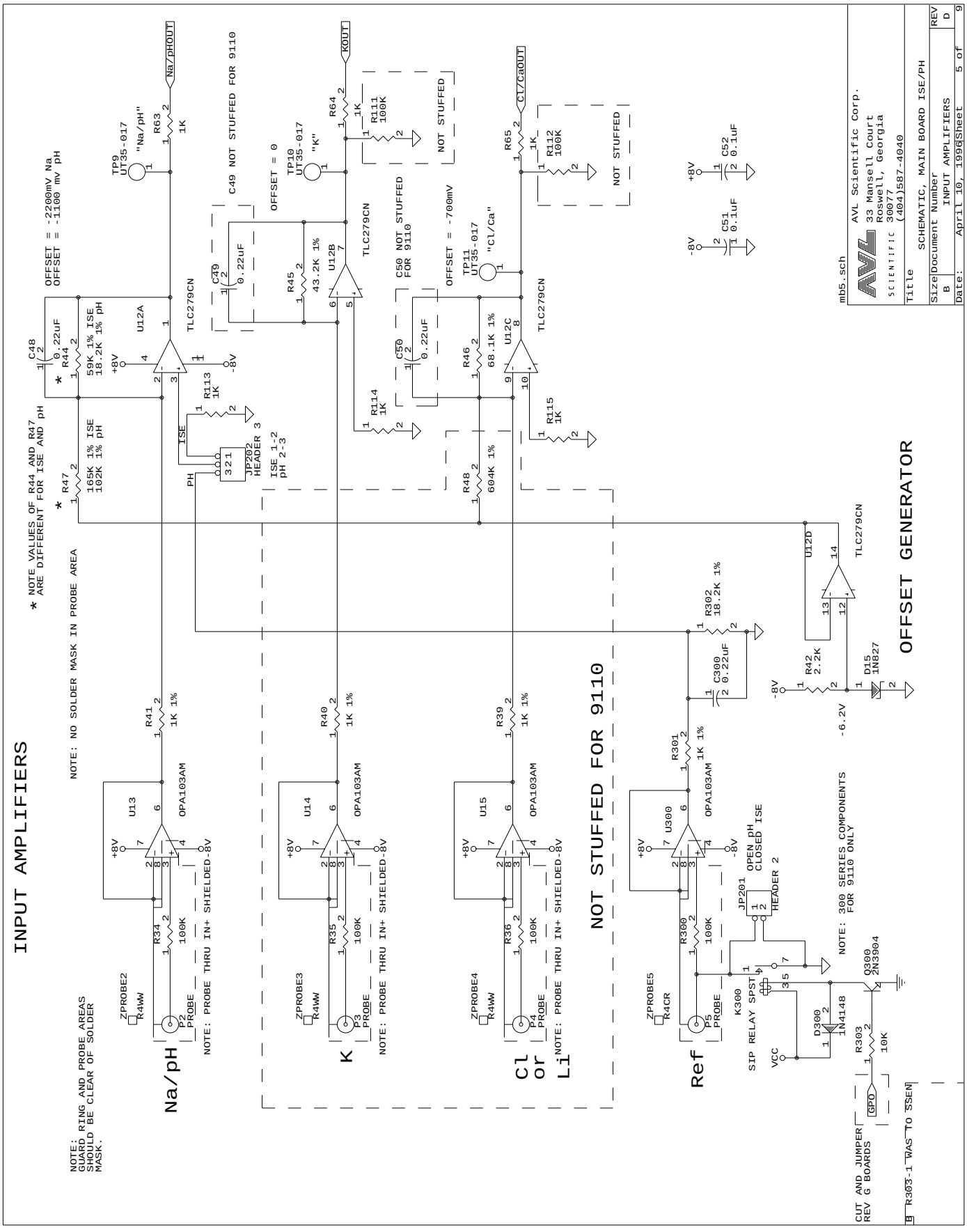



LINK
MB1.SCH
MB2.SCH
MB3.SCH
MB4.SCH
MB5.SCH
MB6.SCH
MB7.SCH
MB8.SCH
MB9.SCH
R900-R903 DO NOT PHYSICALLY EXIST
THEY ARE TO ALLOW GROUNDS TO BE SEPARATED
POWER
JP3
PVCC
PVCC
P+24V
P-12V
P+12V
26-60-4070
MOLEX
MATES WITH MOLEX 09-50-8073
R900 0
R901 0
R902 0
R903 0
DGND
AGND
PGND
SGND
GND
SYSTEM GROUND
JP2
62650-1
AMP
R904
270K_1/4W
PRINTER
JP1
PRINTVCC
DOT1-
DOT2-
DOT3-
DOT4-
DOT5-
DOT6-
DOT7-
MOTOR
TACHO
FEED
CHECK
PGND
EZC10DRXH
SULLINS
RS-232
JP7
DB9P
AMP 1-747871-3
CTS
RS232OUT
RTS
RS232IN
DISPLAY BOARD
JP4
PGND
VCC
VCC
+5VA
SAMPLELED-
SAMPLE
TEMP
CONTRAST
DATA/INST-
DISPRW-
DISPEN
DD0
DD1
DD2
DD3
DD4
DD5
DD6
DD7
+10VO
+24VO
YES-
NO-
SSEN
DD[0..7]
CHR26G-ND
TO DISPLAY BOARD JP2
NOTE:
SAMPLEGND IS RUN INDIVIDUALLY
AND CONNECTED AT THE SHIELD
AREA.
LAMP BOARD
JP5
LAMP+
OVERTEMP-
VALVEA-
VALVEB-
VALVEC-
VALVEV-
VALVE+
VALVER-
PHASEA
PHASEB
PHASEC
PHASED
DLED+
DCLOSED
CHR26G-ND
TO LAMP BOARD JP8
mb1.sch
AVL Scientific Corp.
33 Mansell Court
Roswell, Georgia
SCIENTIFIC 30077
(404)587-4040
Title
SCHEMATIC, MAIN BOARD ISE/PH
Size
B
Document Number
INTERCONNECT
REV
D
Date: April 10, 1996
Sheet 1 of 9
NOTE:REVISION D SCHEMATIC APPLIES TO REVISION H ARTWORK

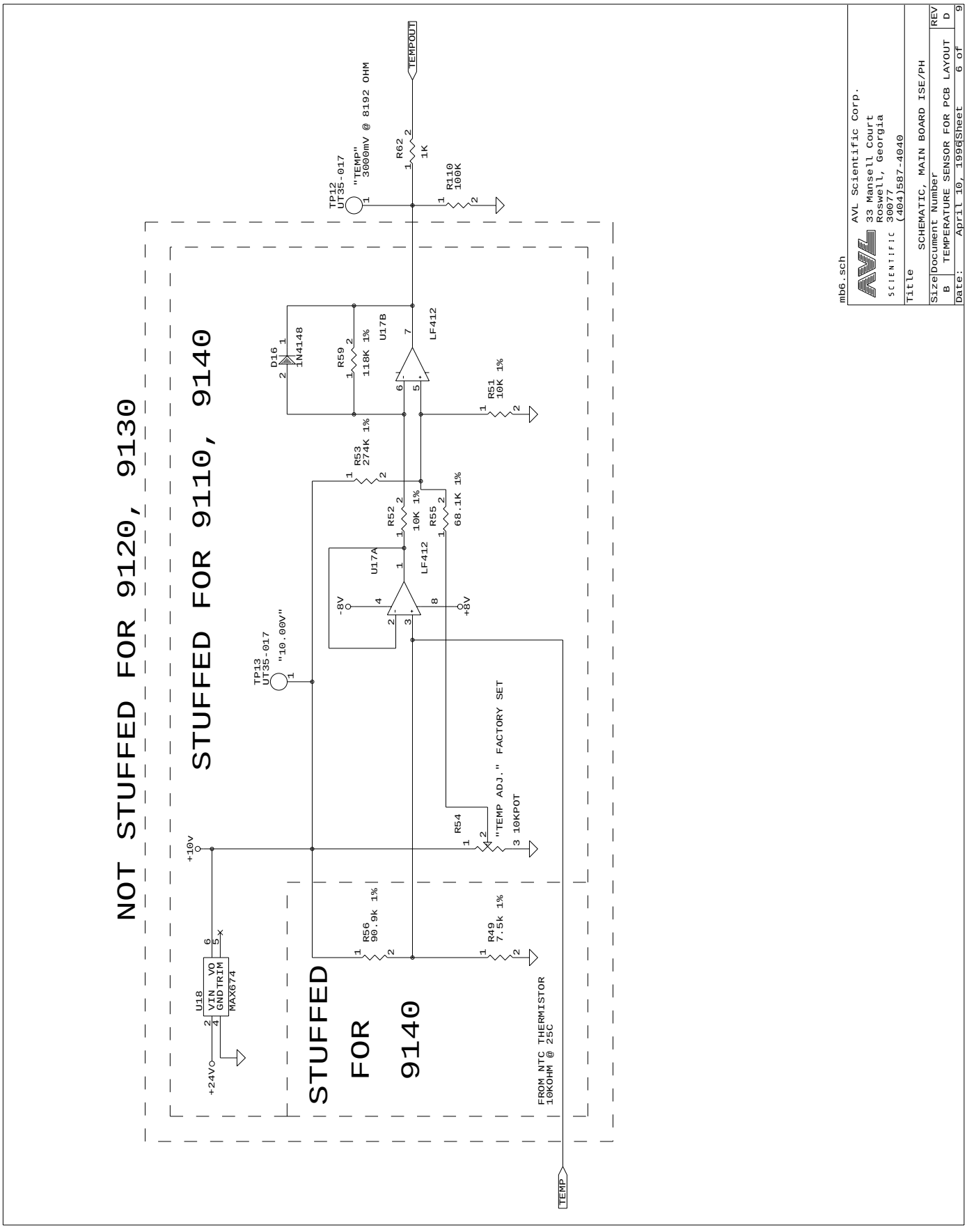

LAMP+
R5
3.9/10W
Q7
MJE800
R103
1K
PRINTVCC
LAMPEN
TP7
UT35-017
"+22V/12V"
+VS
C6
0.1uF
U1
LM317
VIN VOUT
R4
180
R3
1.2K
R2
1.8K
Q1
2N3904
C1
0.1uF
R1
1K
FAST/SLOW-
+24V
TP6
UT35-017
"-8V"
U2
LM7908
C5
0.1uF
C28
10uF/16V
-8V
V-
C2
0.1uF
ZHS1
HEATSINK
TP8
UT35-017
"+8V"
U3
LM7808
C4
0.1uF
C27
10uF/16V
+8V
V+
C3
0.1uF
C64
1000uF/16V
C30
2200uF/16V
C29
2200uF/50V
C25
470uF/25V
C26
470uF/25V
F1
2AT
"2AT"
F2
1.6AT
"1.6AT"
F3
1.25AT
"1.25AT"
F4
0.300AT
"0.300AT"
F5
0.300AT
"0.300AT"
R10
220
R9
220
R8
1.2K
R7
560
R6
560
D1
LED
"+5V/F1"
D2
LED
"+5V/F2"
D3
LED
"+24V/F3"
D4
LED
"-12V/F4"
D5
LED
"+12V/F5"
D6
ICTE.5
TP2
UT35-017
"+5V"
TP1
UT35-017
"+24V"
TP3
UT35-017
"-12V"
TP4
UT35-017
"+12V"
TP5
UT35-017
"GND"
ZCLIP1
FUSECLIP
ZCLIP2
FUSECLIP
ZCLIP3
FUSECLIP
ZCLIP4
FUSECLIP
ZCLIP5
FUSECLIP
ZCLIP6
FUSECLIP
ZCLIP7
FUSECLIP
ZCLIP8
FUSECLIP
ZCLIP9
FUSECLIP
ZCLIP10
FUSECLIP
C7
C8
C9
C10
C11
C12
C65
C66
C67
C68
C69
C70
C71
C13
C14
C15
C16
C17
C18
C19
C20
C21
C22
C23
C24
OPTIONAL
VCC
+8V
-8V
mb2.sch
AVL Scientific Corp.
33 Mansell Court
Roswell, Georgia
30077
(404)587-4040
Title
SCHEMATIC, MAIN BOARD ISE/PH
Size
B
Document Number
POWER SUPPLY
REV
D
Date:
April 10, 1996
Sheet
2 of
9

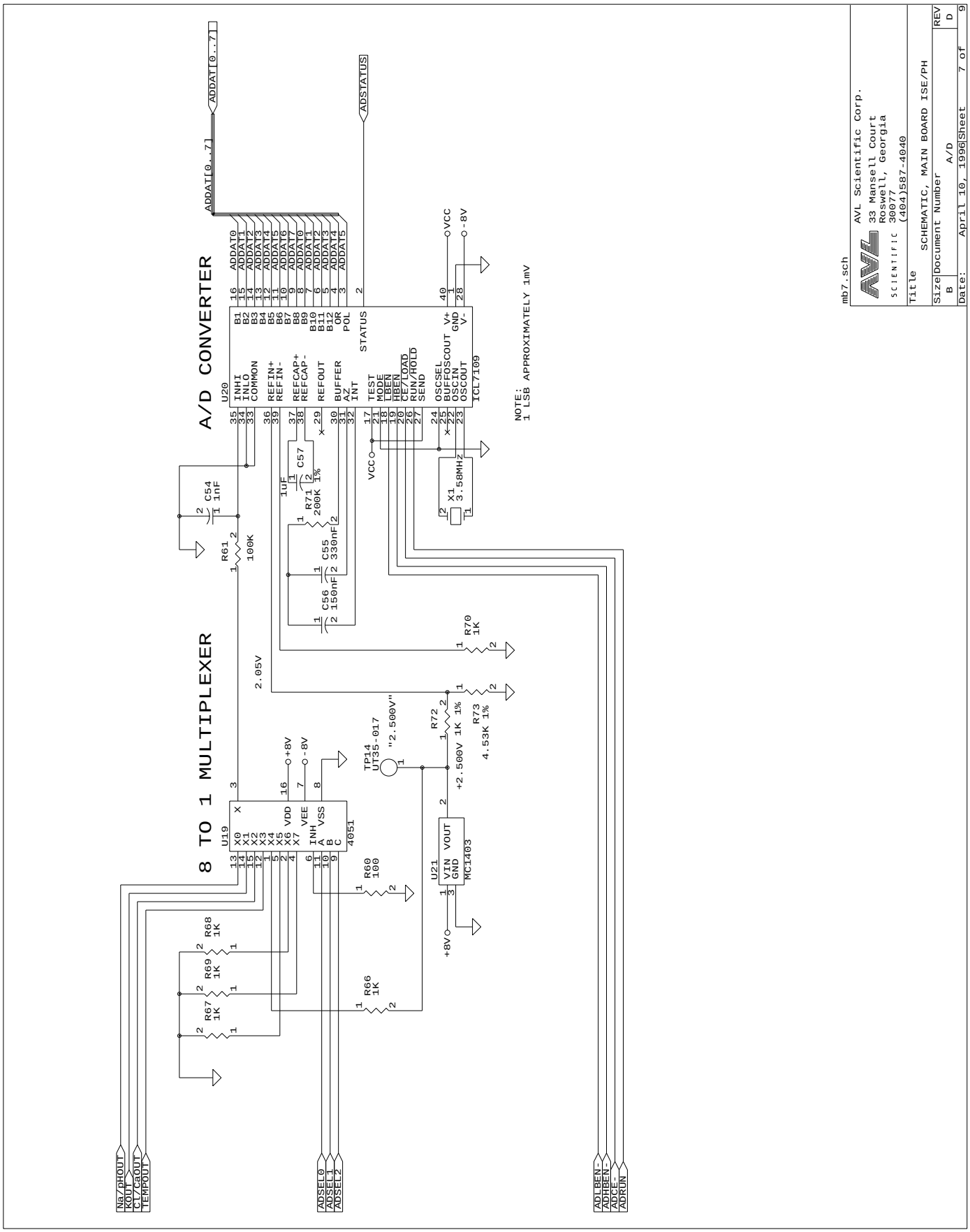

VALVE DRIVERS
mb3.sch
AVL Scientific Corp.
33 Mansell Court
Roswell, Georgia
SCIENTIFIC 30077
(404)587-4040
Title
SCHEMATIC, MAIN BOARD ISE/PH
Size B
Document Number
VALVE DRIVERS
REV D
Date: April 10, 1996 Sheet 3 of 9
U5 LM317 VIN VOUT ADJ
C31 0.1uF
C32 0.1uF
R18 200 1%
R19 1.82K 1%
R20 1.5K
R21 4.7K
ZHS2 HEATSINK
Q8 2N3904
P16 UT35-017
"+22V/12.5V"
+24VO
VALVE+
VALVE-
VALVEA-
VALVEB-
VALVEC-
VALVEV-
VALVER-
THERM-
OVERTEMP-
SGND
OPEN1
OPEN2
OPEN3
OPEN4
OPEN5
C36 2.2uF/50V
C37 2.2uF/50V
C38 2.2uF/50V
C39 2.2uF/50V
C40 2.2uF/50V
Q9 MJE800
Q10 MJE800
Q11 MJE800
Q12 MJE800
Q13 MJE800
R11 1K
R12 1K
R13 1K
R14 1K
R15 1K
R16 360K
R17 180K
R19 WAS 2.37K
R20 WAS 1.5K
R17 WAS 100K

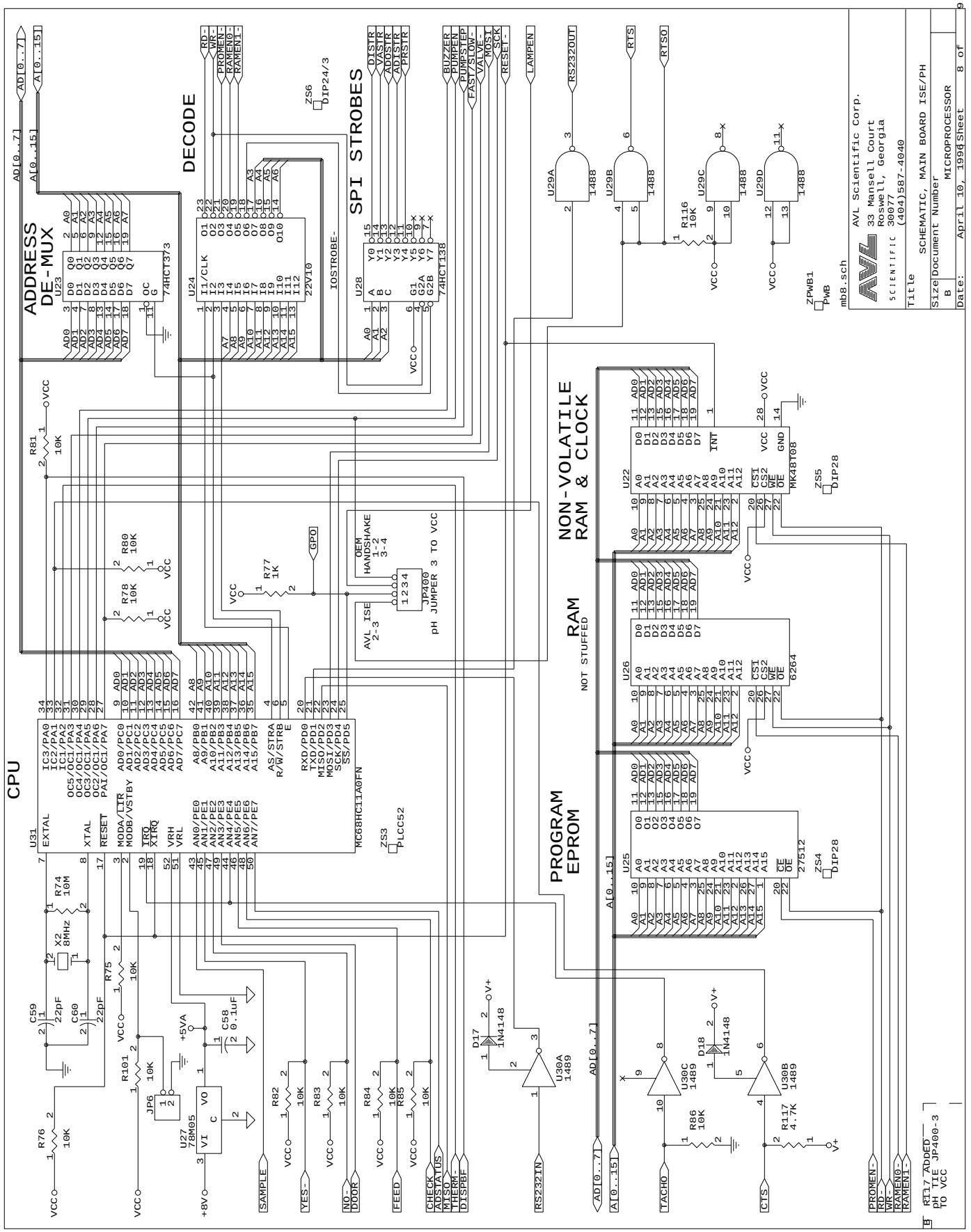

PUMP DRIVER
SAMPLE DOOR SWITCH DETECT
mb4.sch
AVL Scientific Corp.
33 Mansell Court
Roswell, Georgia
30077
(404)587-4040
Title
SCHEMATIC, MAIN BOARD ISE/PH
Size
B
Document Number
PUMP MOTOR DRIVER/COVER SENSOR
REV
D
Date:
April 10, 1996
Sheet
4 of 9
PHASEA
PHASEB
PHASEC
PHASED
PUMPSTEP
PUMPEN
SGND
VCC
+VS
+22V/12V
DOOR
DLED+
SAMPLE DOOR
DCLOSED
U9
L293E
U10
L297
U11
LM311N
ZS1
ZS2
DIP20
D7 1N4004
D8 1N4004
D9 1N4004
D10 1N4004
D11 1N4004
D12 1N4004
D13 1N4004
D14 1N4004
C41 0.1uF
C42 0.1uF
C43 3.3nF
C44 0.1uF
C45 0.1uF
C46 100uF/50V
C47 10uF/16V
R23 22K
R24 10K 1%
R25 1
R26 1
R27 100
R28 10K
R29 10K
R30 33K
R31 100K
R32 562 1%
R33 2.2K

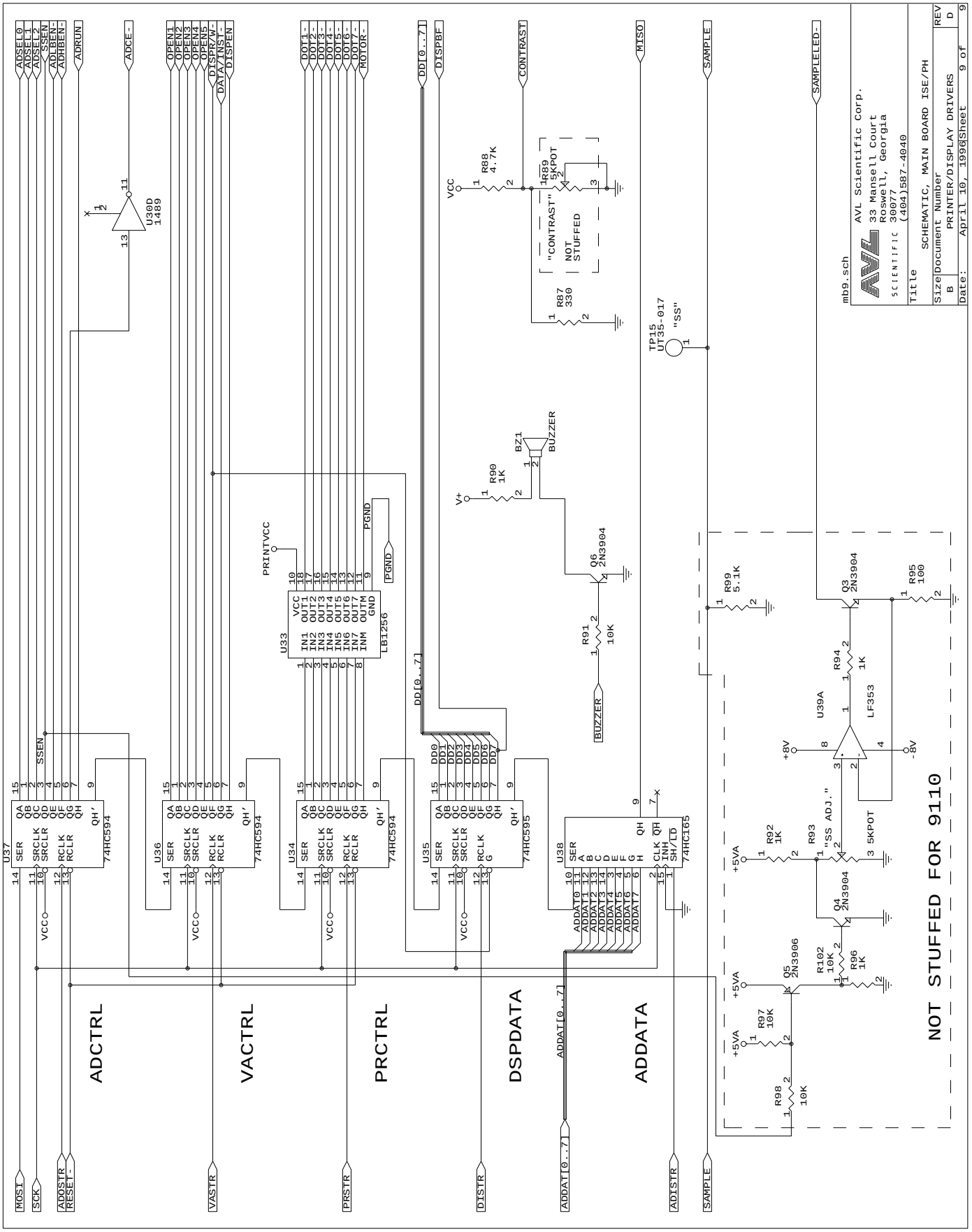

INPUT AMPLIFIERS
* NOTE VALUES OF R44 AND R47 ARE DIFFERENT FOR ISE AND pH
NOTE: NO SOLDER MASK IN PROBE AREA
NOTE: GUARD RING AND PROBE AREAS SHOULD BE CLEAR OF SOLDER MASK.
Na/pH
K
Cl or Li
Ref
NOT STUFFED FOR 9110
OFFSET GENERATOR
OFFSET = -2200mV Na
OFFSET = -1100 mv pH
OFFSET = 0
OFFSET = -700mV
C49 NOT STUFFED FOR 9110
C50 NOT STUFFED FOR 9110
NOT STUFFED
ISE 1-2
pH 2-3
NOTE: PROBE THRU IN+ SHIELDED-8V
NOTE: 300 SERIES COMPONENTS FOR 9110 ONLY
OPEN pH CLOSED ISE
SIP RELAY SPST
CUT AND JUMPER REV G BOARDS
R303-1 WAS TO SSEN
AVL Scientific Corp.
33 Mansell Court
Roswell, Georgia
30077
(404)587-4040
SCHEMATIC, MAIN BOARD ISE/PH
INPUT AMPLIFIERS
April 10, 1996
Sheet 5 of 9

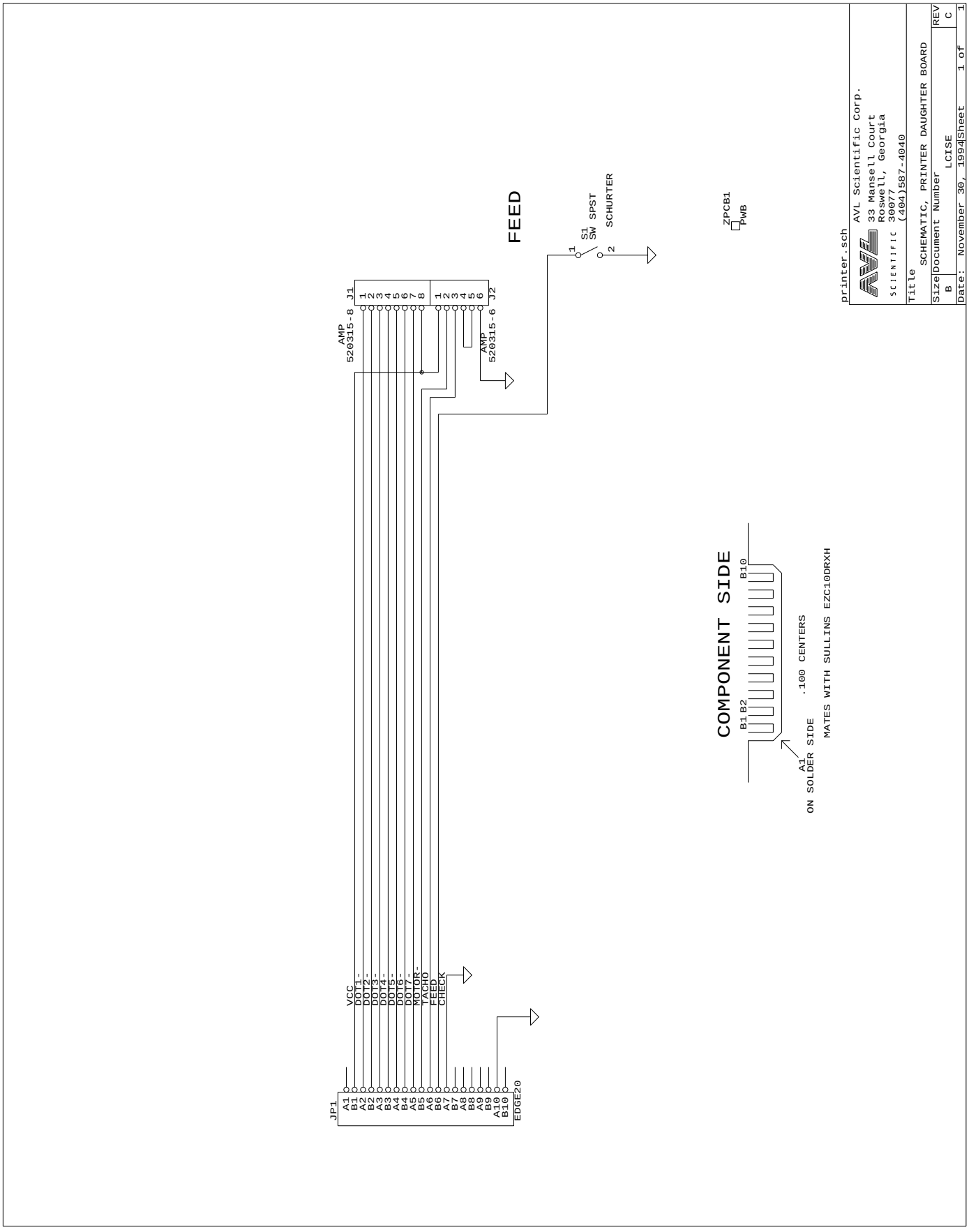
SBC PCB - TEMPERATURE CIRCUIT - 9120, 30, 40

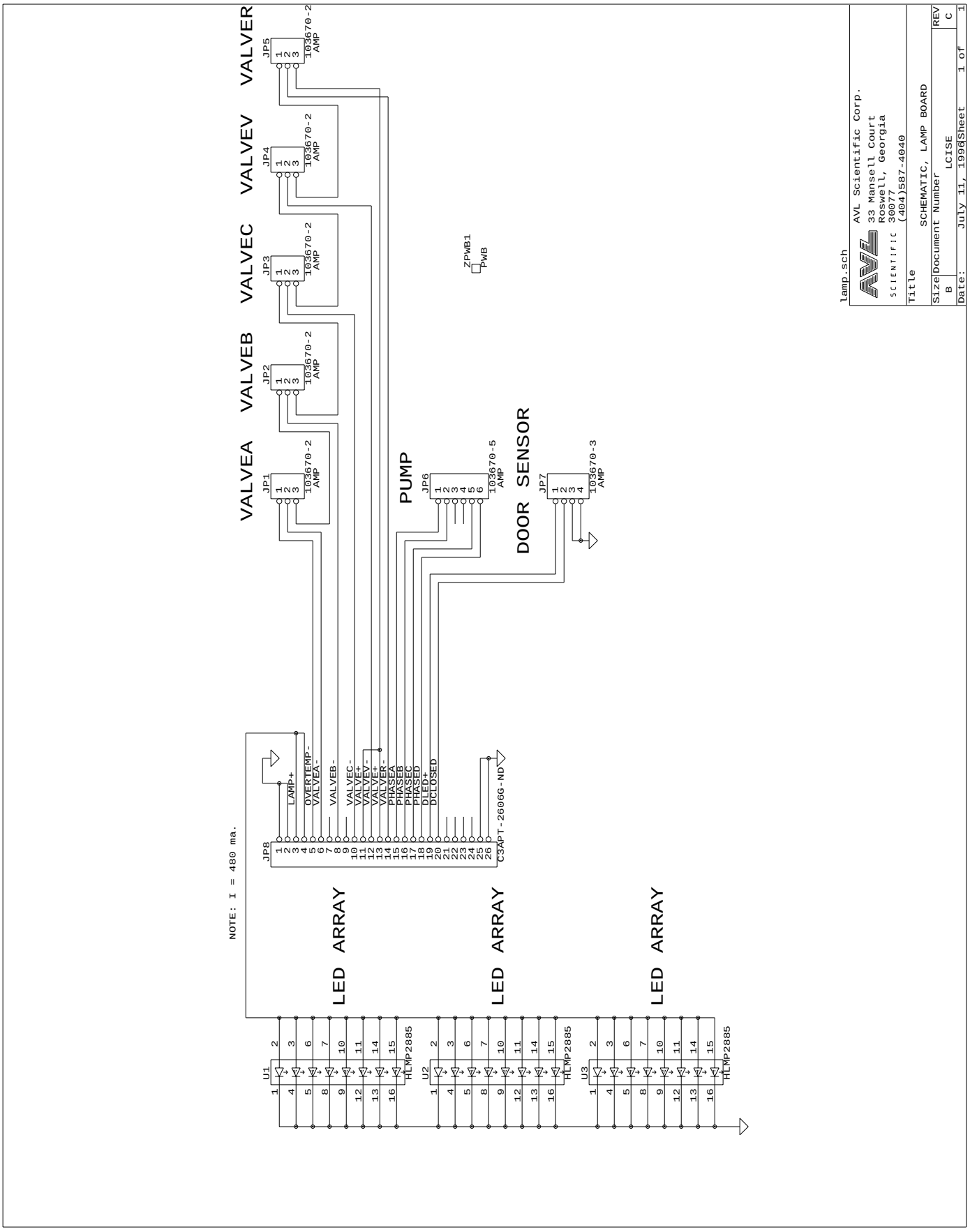


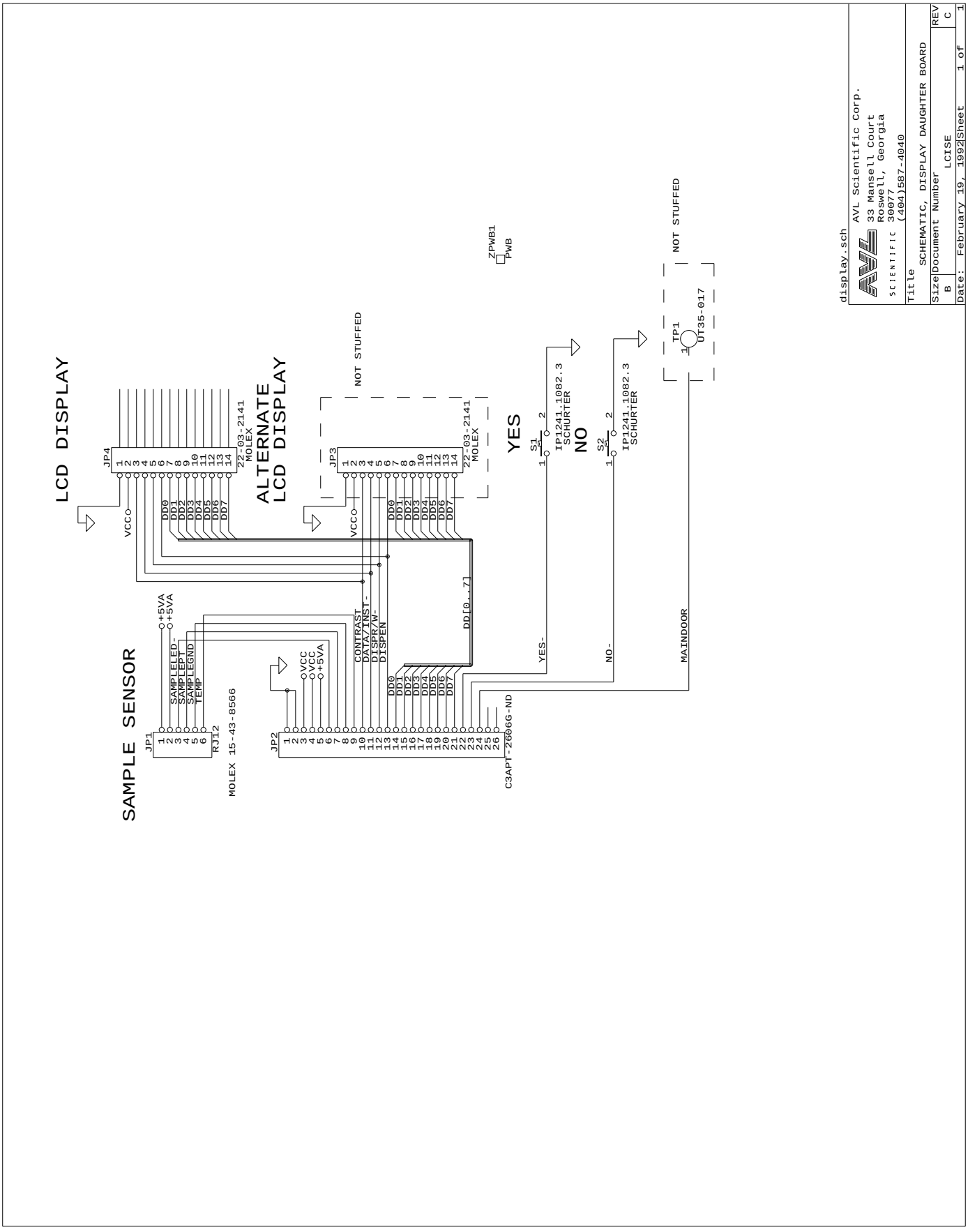

8 TO 1 MULTIPLEXER
A/D CONVERTER
U19
4051
U20
ICL7109
U21
MC1403
X1
3.58MHZ
C54 1nF
C55 330nF
C56 150nF
C57 1uF
R61 100K
R71 200K 1%
R72 1K 1%
R73 4.53K 1%
R60 100
R66 1K
R67 1K
R68 1K
R69 1K
R70 1K
TP14 UT35-017
"2.500V"
+2.500V
2.05V
+8V
-8V
VCC
ADDAT[0..7]
ADSTATUS
NOTE:
1 LSB APPROXIMATELY 1mV
Na/pHOUT
KOUT
CLC/CaOUT
TEMPOUT
ADSEL0
ADSEL1
ADSEL2
ADLBEN-
ADHBEN-
ADCE-
ADRUN
mb7.sch
AVL Scientific Corp.
33 Mansell Court
Roswell, Georgia
30077
(404)587-4040
Title
SCHEMATIC, MAIN BOARD ISE/PH
Size B
Document Number A/D
REV D
Date: April 10, 1996 Sheet 7 of 9

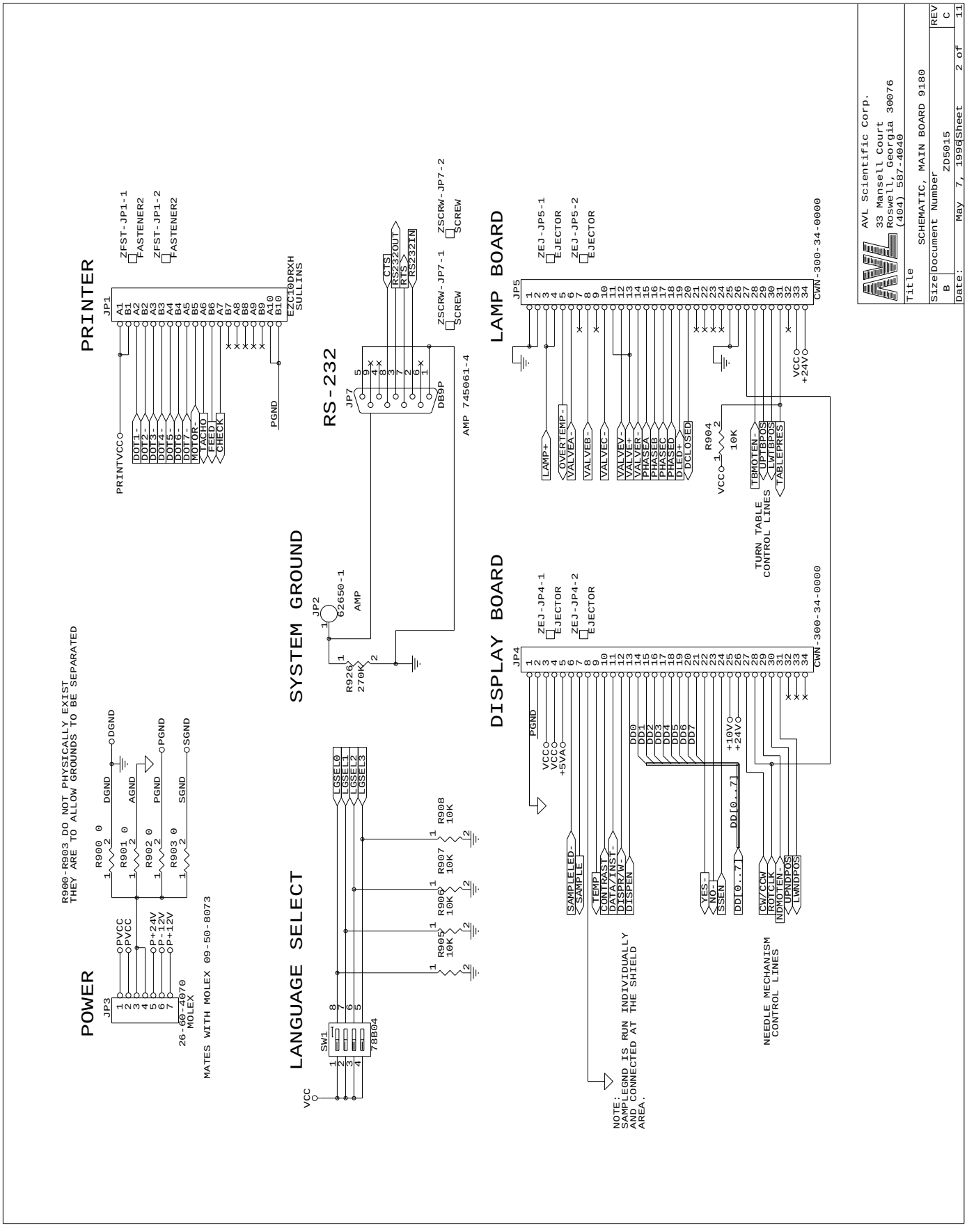

CPU
ADDRESS DE-MUX
DECODE
SPI STROBES
NON-VOLATILE RAM & CLOCK
PROGRAM EPROM
RAM
NOT STUFFED
AVL Scientific Corp.
33 Mansell Court
Roswell, Georgia
30077
(404)587-4040
Title SCHEMATIC, MAIN BOARD ISE/PH
Size B
Document Number MICROPROCESSOR
REV D
Date: April 10, 1996 Sheet 8 of 9
mb8.sch

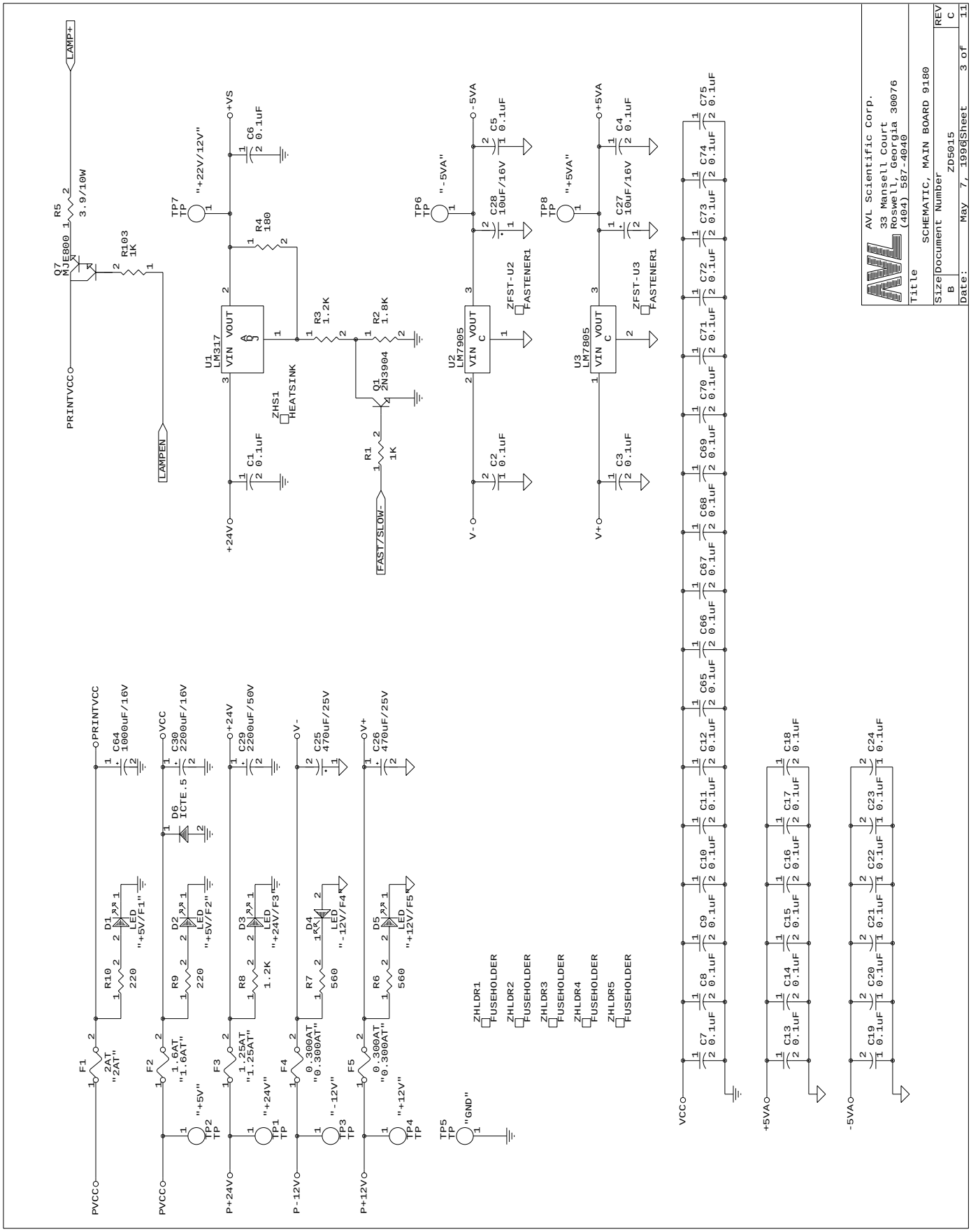

ADCTRL
VACTRL
PRCTRL
DSPDATA
ADDATA
NOT STUFFED FOR 9110
"CONTRAST" NOT STUFFED
"SS ADJ."
BUZZER
AVL Scientific Corp.
33 Mansell Court
Roswell, Georgia
SCIENTIFIC 30077
(404)587-4040
Title SCHEMATIC, MAIN BOARD ISE/PH
Size B
Document Number PRINTER/DISPLAY DRIVERS
REV D
Date: April 10, 1996 Sheet 9 of 9

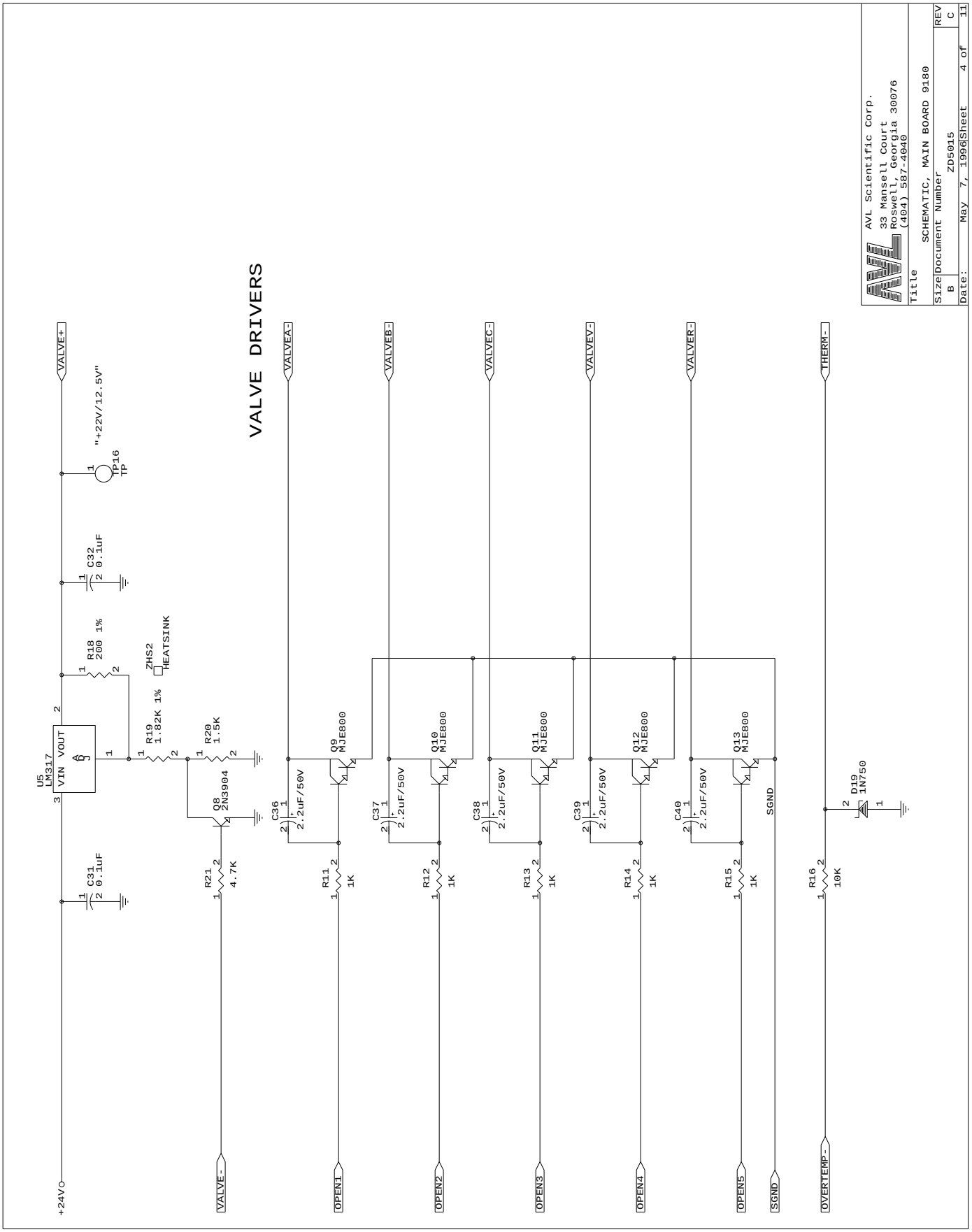

JP1
A1
B1
A2
B2
A3
B3
A4
B4
A5
B5
A6
B6
A7
B7
A8
B8
A9
B9
A10
B10
EDGE20
VCC
DOT1-
DOT2-
DOT3-
DOT4-
DOT5-
DOT6-
DOT7-
MOTOR-
MOTOR0
FEED
CHECK
AMP
520315-8 J1
1
2
3
4
5
6
7
8
AMP
520315-6 J2
1
2
3
4
5
6
FEED
S1
SW SPST
SCHURTER
1
2
ZPCB1
PWB
COMPONENT SIDE
B1 B2
B10
A1
ON SOLDER SIDE
.100 CENTERS
MATES WITH SULLINS EZC10DRXH
printer.sch
AVL Scientific Corp.
33 Mansell Court
Roswell, Georgia
SCIENTIFIC 30077
(404)587-4040
Title
SCHEMATIC, PRINTER DAUGHTER BOARD
Size
B
Document Number
LCISE
REV
C
Date: November 30, 1994
Sheet
1 of
1

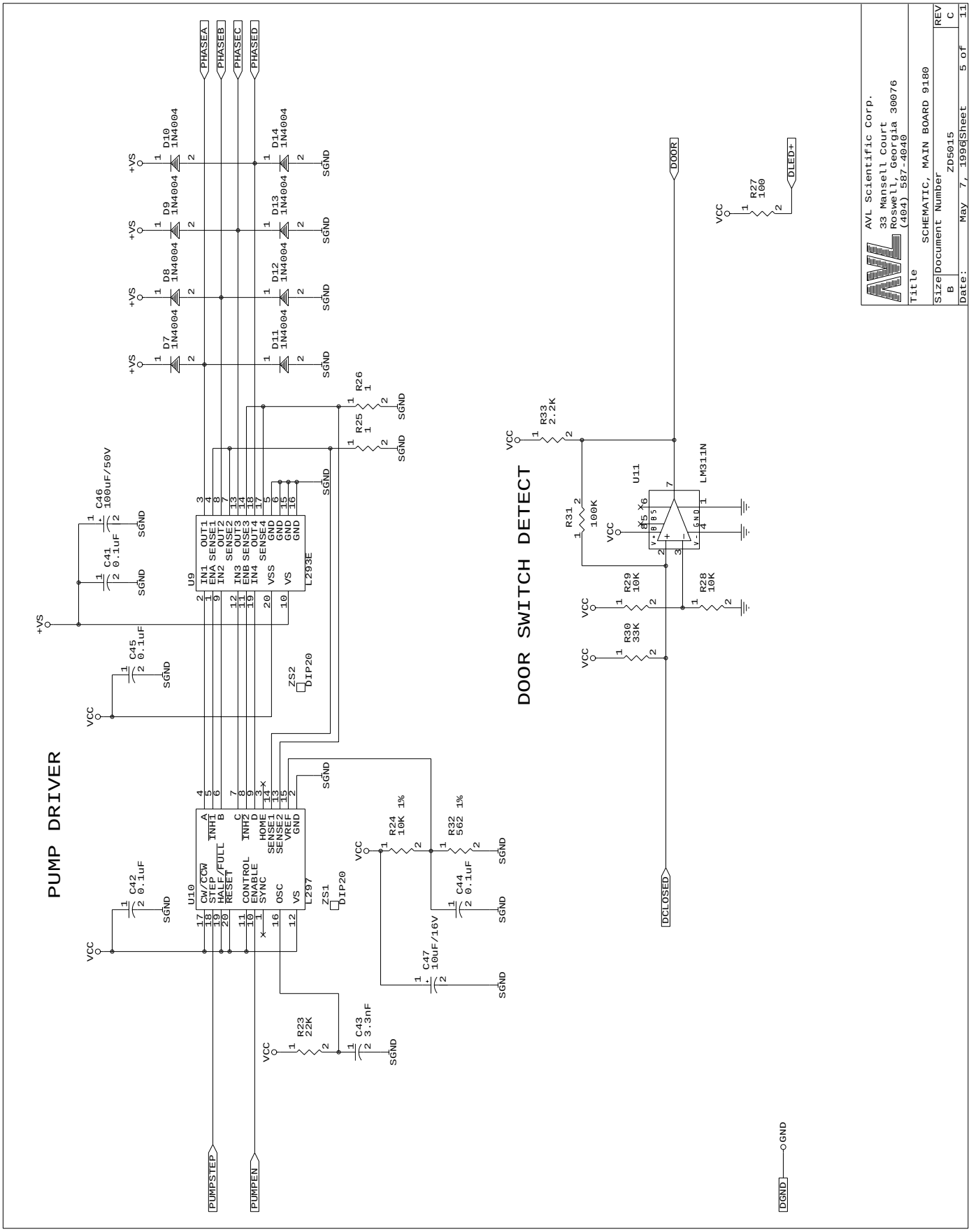

VALVEA
VALVEB
VALVEC
VALVEV
VALVER
PUMP
DOOR SENSOR
LED ARRAY
LED ARRAY
LED ARRAY
NOTE: I = 480 ma.
JP1
JP2
JP3
JP4
JP5
JP6
JP7
JP8
103670-2 AMP
103670-5 AMP
103670-3 AMP
C3APT-2606G-ND
HLMP2885
U1
U2
U3
LAMP+
OVERTEMP-
VALVEA-
VALVEB-
VALVEC-
VALVE+
VALVEV-
VALVE+
VALVER-
PHASEA
PHASEB
PHASEC
PHASED
DLED+
DCLOSED
ZPWB1
PWB
lamp.sch
AVL Scientific Corp.
33 Mansell Court
Roswell, Georgia
30077
(404)587-4040
Title
SCHEMATIC, LAMP BOARD
Size
B
Document Number
LCISE
REV
C
Date:
July 11, 1996
Sheet
1 of
1

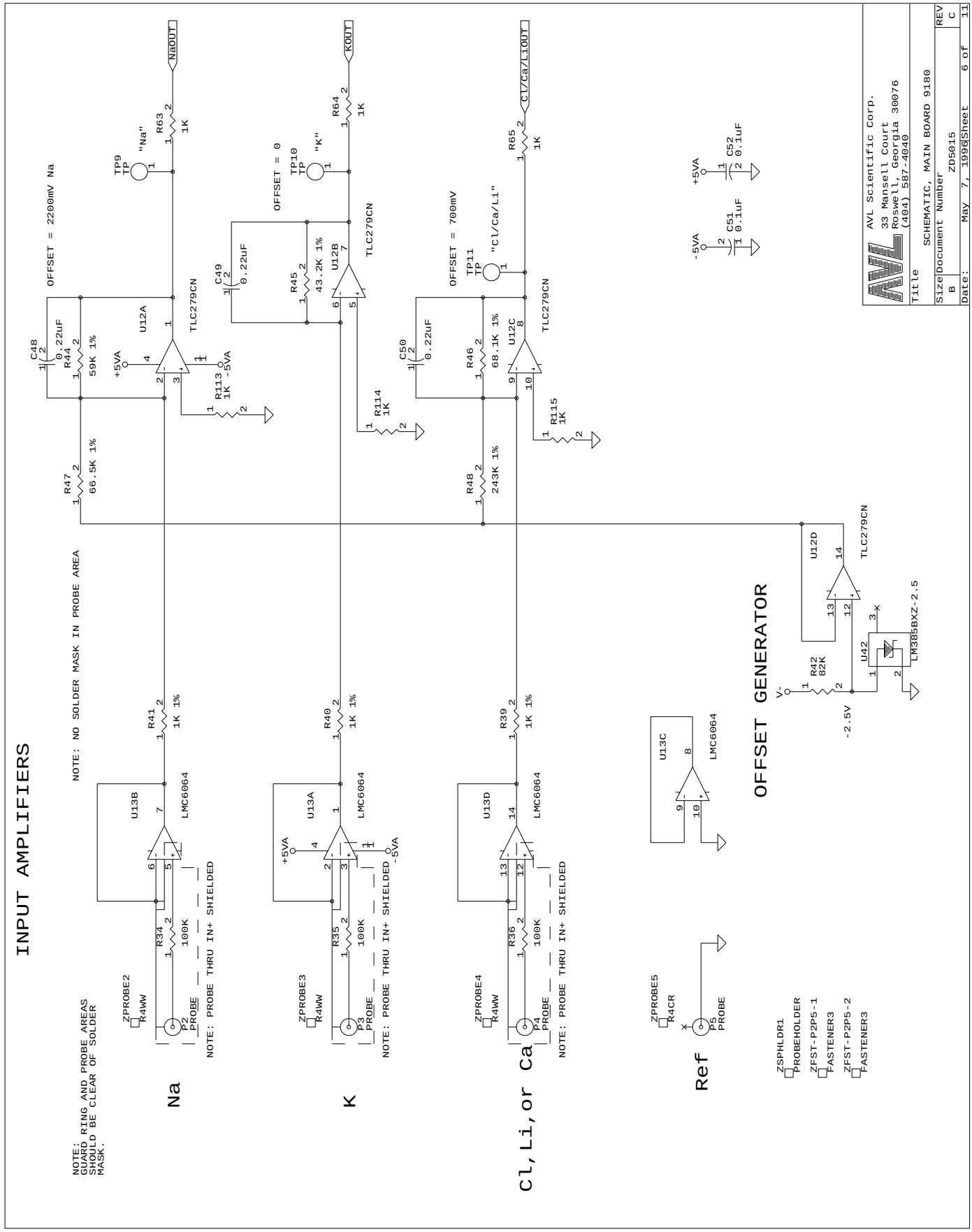

LCD DISPLAY
SAMPLE SENSOR
ALTERNATE LCD DISPLAY
NOT STUFFED
YES
NO
NOT STUFFED
JP1
JP2
JP3
JP4
RJ12
MOLEX 15-43-8566
22-03-2141 MOLEX
C3APT-2606G-ND
S1
S2
IP1241.1082.3 SCHURTER
TP1
UT35-017
ZPWB1 PWB
SAMPLELED-
SAMPLEDT
SAMPLEGND
TEMP
CONTRAST
DATA/INST
DISPR/W-
DISPEN
DD[0..7]
YES-
NO-
MAINDOOR
VCC
+5VA
display.sch
AVL Scientific Corp.
33 Mansell Court
Roswell, Georgia
SCIENTIFIC 30077
(404)587-4040
Title
SCHEMATIC, DISPLAY DAUGHTER BOARD
Size B
Document Number LCISE
REV C
Date: February 19, 1992 Sheet 1 of 1


PRINTER
JP1
ZFST-JP1-1
FASTENER2
ZFST-JP1-2
FASTENER2
PRINTVCC
DOT1-
DOT2-
DOT3-
DOT4-
DOT5-
DOT6-
DOT7-
MOTOR-
TACHO
FEED
CHECK
PGND
EZC10DRXH
SULLINS
RS-232
JP7
DB9P
AMP 745061-4
CTS
RS232OUT
RTS
RS232IN
ZSCRW-JP7-1
SCREW
ZSCRW-JP7-2
SCREW
SYSTEM GROUND
JP2
62650-1
AMP
R926
270K
POWER
JP3
26-60-4070
MOLEX
MATES WITH MOLEX 09-50-8073
PVCC
P+24V
P+12V
DGND
AGND
PGND
SGND
R900 0
R901 0
R902 0
R903 0
R900-R903 DO NOT PHYSICALLY EXIST
THEY ARE TO ALLOW GROUNDS TO BE SEPARATED
LANGUAGE SELECT
SW1
78B04
VCC
LGSEL0
LGSEL1
LGSEL2
LGSEL3
R905
10K
R906
10K
R907
10K
R908
10K
DISPLAY BOARD
JP4
CWN-300-34-0000
ZEJ-JP4-1
EJECTOR
ZEJ-JP4-2
EJECTOR
PGND
VCC
VCC
+5VA
SAMPLELED-
SAMPLE
TEMP
CONTRAST
DATA/INST-
DISPRW-
DISPEN
DD0
DD1
DD2
DD3
DD4
DD5
DD6
DD7
+10V
+24V
DD[0..7]
YES-
NO-
SSEN
CW/CCW
ROTCLK
NDMOTEN-
UPNDPOS
LWNDPOS
NEEDLE MECHANISM
CONTROL LINES
NOTE:
SAMPLEGND IS RUN INDIVIDUALLY
AND CONNECTED AT THE SHIELD
AREA.
LAMP BOARD
JP5
CWN-300-34-0000
ZEJ-JP5-1
EJECTOR
ZEJ-JP5-2
EJECTOR
LAMP+
OVERTEMP-
VALVEA-
VALVEB-
VALVEC-
VALVEV-
VALVEV+
VALVER-
PHASEA
PHASEB
PHASEC
PHASED
DLED+
DCLOSED
R904
10K
VCC
VCC
+24VO
TBMOTEN-
UPTBPOS
LWTBPOS
TABLEPRES
TURN TABLE
CONTROL LINES
AVL Scientific Corp.
33 Mansell Court
Roswell, Georgia 30076
(404) 587-4040
Title
SCHEMATIC, MAIN BOARD 9180
Size
B
Document Number
ZD5015
REV
C
Date: May 7, 1996
Sheet 2 of 11

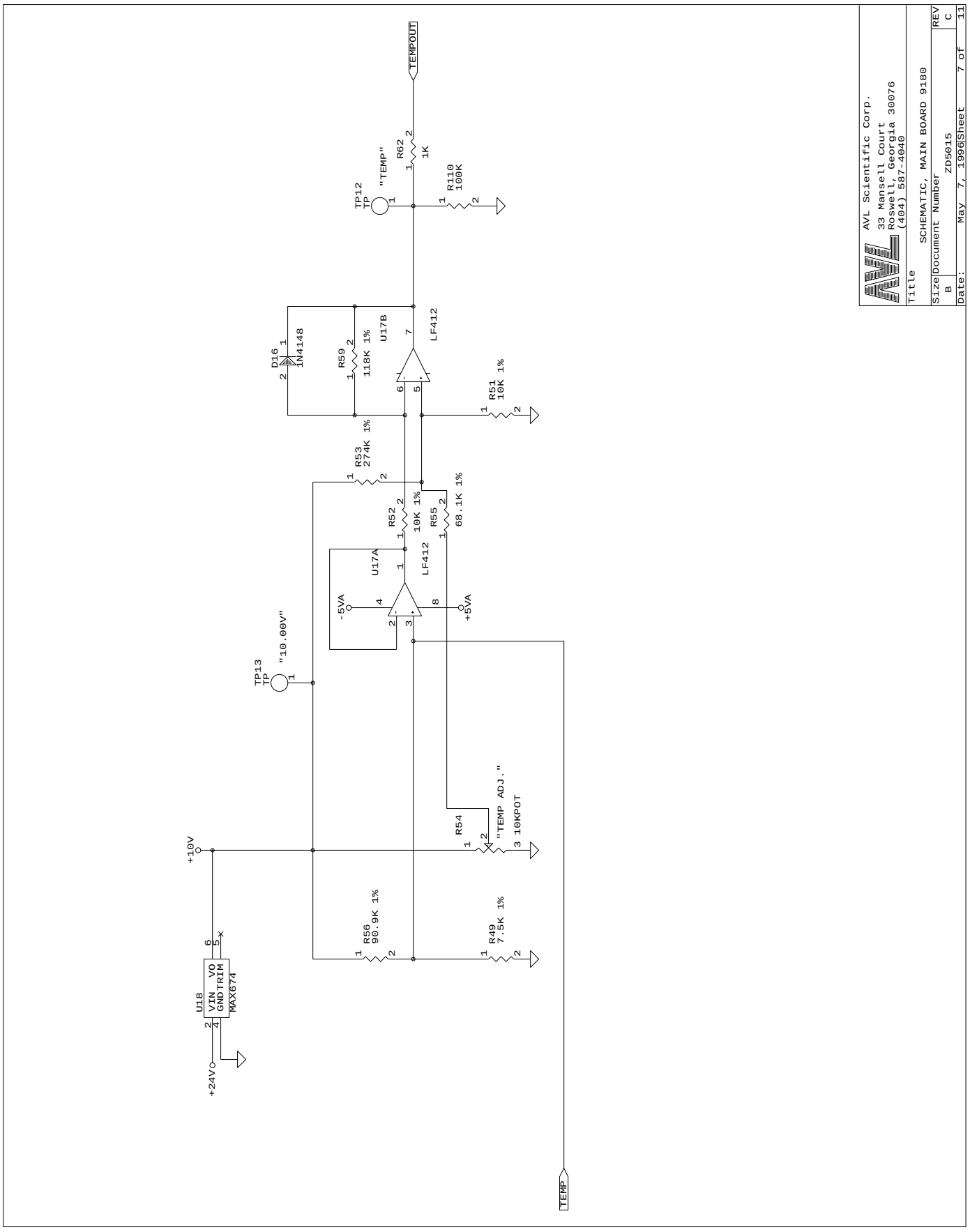

AVL Scientific Corp.
33 Mansell Court
Roswell, Georgia 30076
(404) 587-4040
Title
SCHEMATIC, MAIN BOARD 9180
Size Document Number ZD5015 REV C
Date: May 7, 1996 Sheet 3 of 11
LAMP+
PRINTVCC
LAMPEN
FAST/SLOW-
Q7 NJE800
R5 3.9/10W
R103 1K
U1 LM317
R3 1.2K
R4 180
R2 1.8K
R1 1K
Q1 2N3904
ZHS1 HEATSINK
TP7 "+22V/12V"
C1 0.1uF
C6 0.1uF
U2 LM7905
TP6 "-5VA"
C2 0.1uF
C5 0.1uF
C28 10uF/16V
ZFST-U2 FASTENER1
U3 LM7805
TP8 "+5VA"
C3 0.1uF
C4 0.1uF
C27 10uF/16V
ZFST-U3 FASTENER1
F1 2AT "2AT"
F2 1.6AT "1.6AT"
F3 1.25AT "1.25AT"
F4 0.300AT "0.300AT"
F5 0.300AT "0.300AT"
D1 LED "+5V/F1"
D2 LED "+5V/F2"
D3 LED "+24V/F3"
D4 LED "-12V/F4"
D5 LED "+12V/F5"
D6 ICTE.5
R10 220
R9 220
R8 1.2K
R7 560
R6 560
C64 1000uF/16V
C30 2200uF/16V
C29 2200uF/50V
C25 470uF/25V
C26 470uF/25V
TP1 "+24V"
TP2 "+5V"
TP3 "-12V"
TP4 "+12V"
TP5 "GND"
ZHLDR1 FUSEHOLDER
ZHLDR2 FUSEHOLDER
ZHLDR3 FUSEHOLDER
ZHLDR4 FUSEHOLDER
ZHLDR5 FUSEHOLDER
C7 0.1uF
C8 0.1uF
C9 0.1uF
C10 0.1uF
C11 0.1uF
C12 0.1uF
C65 0.1uF
C66 0.1uF
C67 0.1uF
C68 0.1uF
C69 0.1uF
C70 0.1uF
C71 0.1uF
C72 0.1uF
C73 0.1uF
C74 0.1uF
C75 0.1uF
C13 0.1uF
C14 0.1uF
C15 0.1uF
C16 0.1uF
C17 0.1uF
C18 0.1uF
C19 0.1uF
C20 0.1uF
C21 0.1uF
C22 0.1uF
C23 0.1uF
C24 0.1uF
PRINTVCC
PVCC
VCC
+24V
P+24V
P-12V
P+12V
V-
V+
+5VA
-5VA

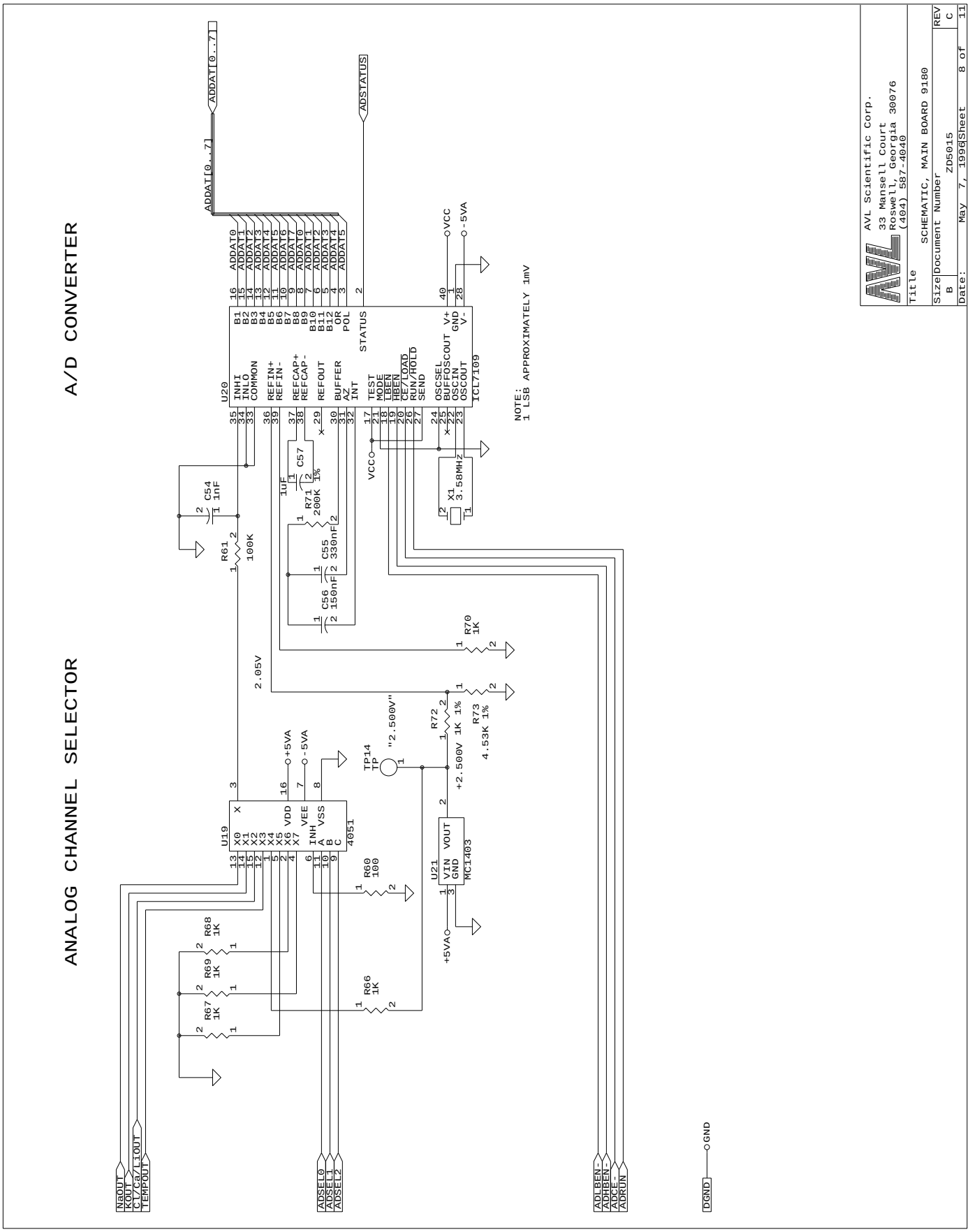

VALVE DRIVERS
AVL Scientific Corp.
33 Mansell Court
Roswell, Georgia 30076
(404) 587-4040
Title
SCHEMATIC, MAIN BOARD 9180
Size B
Document Number
ZD5015
REV C
Date: May 7, 1998 Sheet 4 of 11
VALVE+
"+22V/12.5V"
TP16
TP
C32
0.1uF
R18
200 1%
ZHS2
HEATSINK
U5
LM317
VIN VOUT
ADJ
R19
1.82K 1%
R20
1.5K
Q8
2N3904
C31
0.1uF
R21
4.7K
+24VO
VALVE-
VALVEA-
VALVEB-
VALVEC-
VALVEV-
VALVER-
THERM-
C36
2.2uF/50V
C37
2.2uF/50V
C38
2.2uF/50V
C39
2.2uF/50V
C40
2.2uF/50V
Q9
MJE800
Q10
MJE800
Q11
MJE800
Q12
MJE800
Q13
MJE800
R11
1K
R12
1K
R13
1K
R14
1K
R15
1K
R16
10K
D19
1N750
OPEN1
OPEN2
OPEN3
OPEN4
OPEN5
SGND
OVERTEMP-

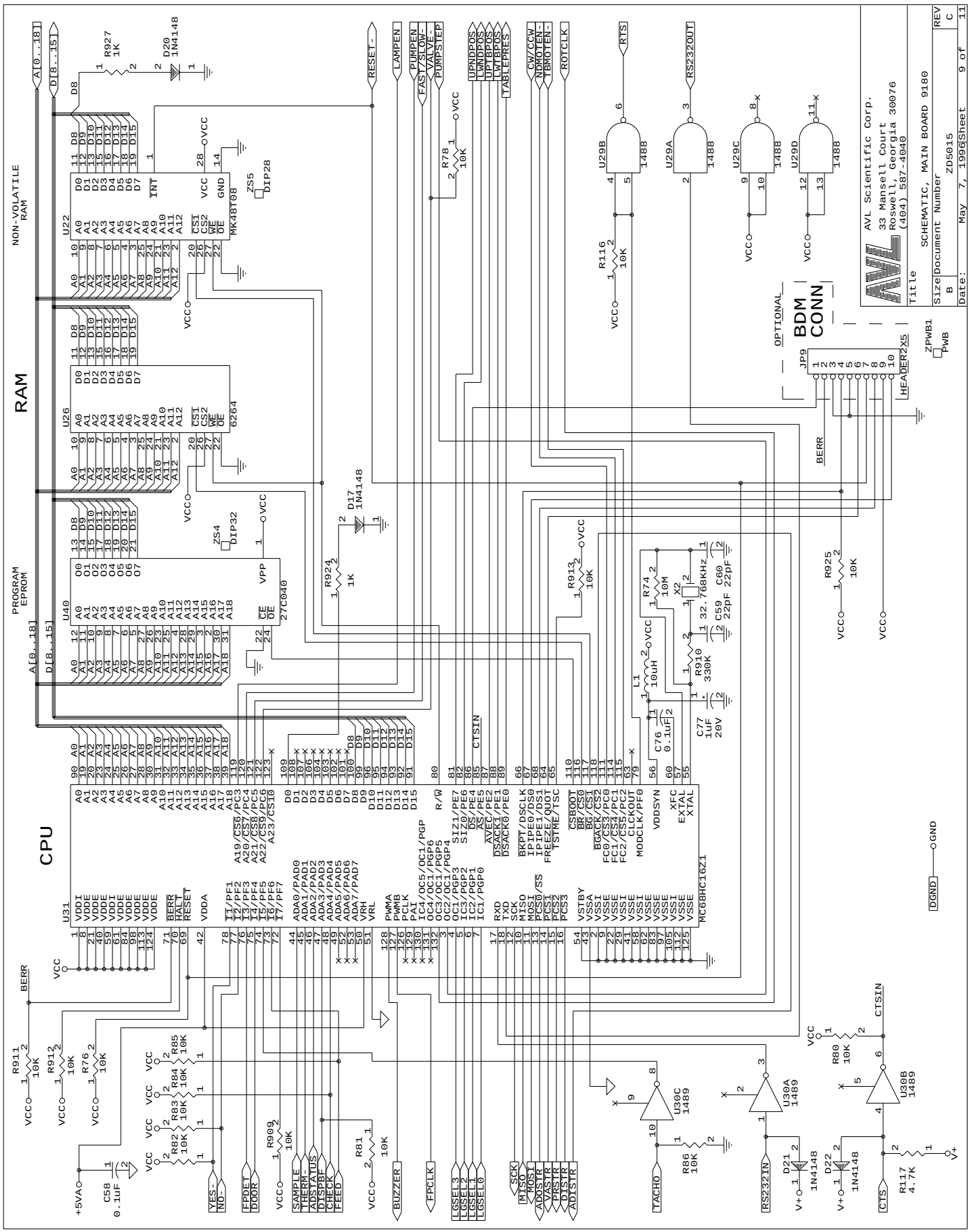

PUMP DRIVER
DOOR SWITCH DETECT
AVL Scientific Corp.
33 Mansell Court
Roswell, Georgia 30076
(404) 587-4040
Title SCHEMATIC, MAIN BOARD 9180
Size B
Document Number ZD5015
REV C
Date: May 7, 1996 Sheet 5 of 11
U9 L293E
U10 L297
U11 LM311N
PHASEA
PHASEB
PHASEC
PHASED
PUMPSTEP
PUMPEN
DOOR
DCLOSED
DLED+
DGND
+VS
VCC
SGND

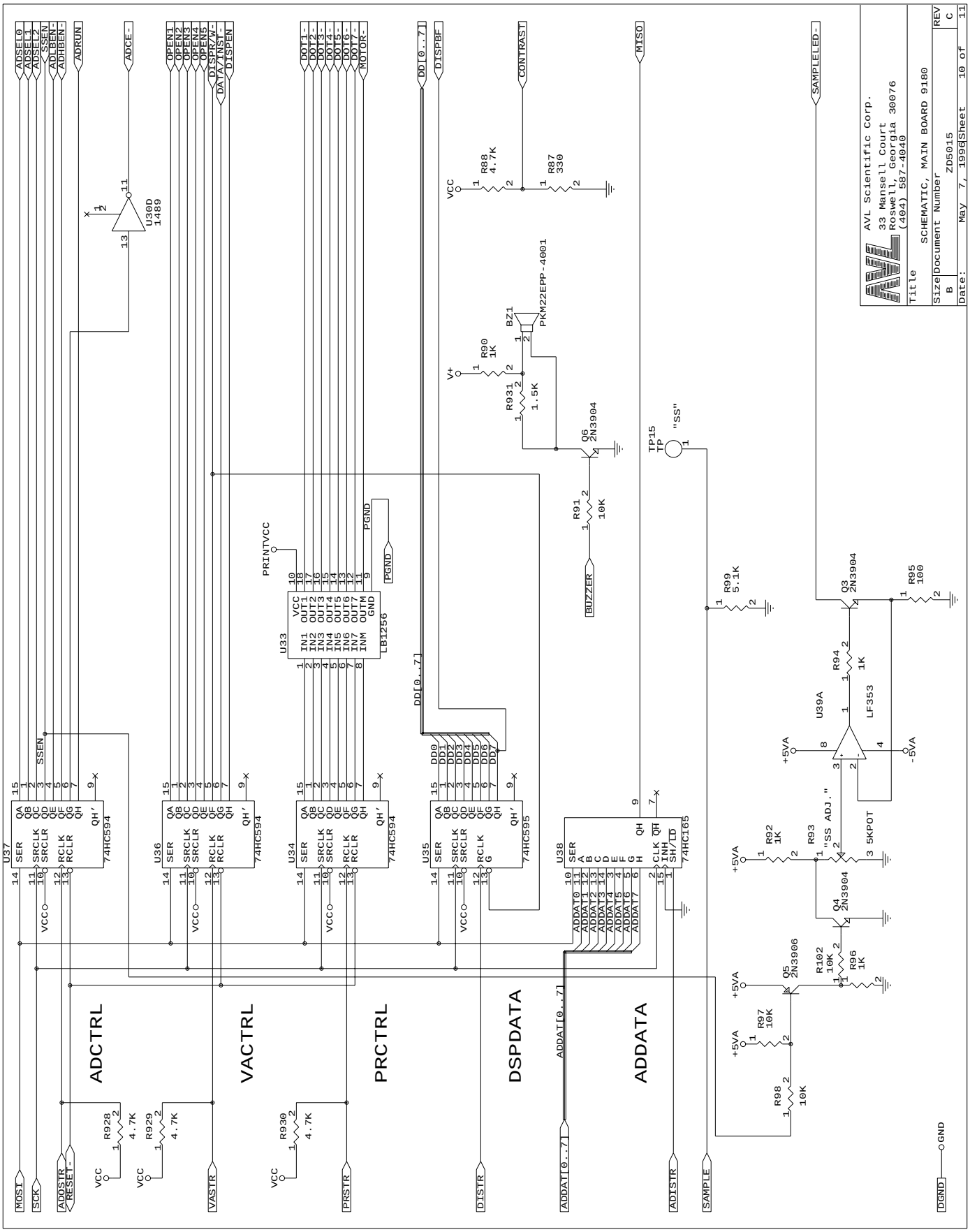

INPUT AMPLIFIERS
NOTE: NO SOLDER MASK IN PROBE AREA
NOTE: RING AND PROBE AREAS SHOULD BE CLEAR OF SOLDER MASK.
OFFSET = 2200mV Na
OFFSET = 0
OFFSET = 700mV
NaOUT
KOUT
Cl/Ca/LiOUT
TP9 TP "Na"
TP10 TP "K"
TP11 TP "Cl/Ca/Li"
C48 0.22uF
C49 0.22uF
C50 0.22uF
C51 0.1uF
C52 0.1uF
R44 59K 1%
R45 43.2K 1%
R46 68.1K 1%
R47 66.5K 1%
R48 243K 1%
R63 1K
R64 1K
R65 1K
R113 1K
R114 1K
R115 1K
R34 100K
R35 100K
R36 100K
R39 1K 1%
R40 1K 1%
R41 1K 1%
R42 82K
U12A TLC279CN
U12B TLC279CN
U12C TLC279CN
U12D TLC279CN
U13A LMC6064
U13B LMC6064
U13C LMC6064
U13D LMC6064
U42 LM385BXZ-2.5
+5VA
-5VA
-2.5V
Na
K
Cl,Li,or Ca
Ref
OFFSET GENERATOR
ZPROBE2 R4WW P2 PROBE
ZPROBE3 R4WW P3 PROBE
ZPROBE4 R4WW P4 PROBE
ZPROBE5 R4CR P5 PROBE
NOTE: PROBE THRU IN+ SHIELDED
ZSPHLDR1 PROBEHOLDER
ZFST-P2P5-1 FASTENER3
ZFST-P2P5-2 FASTENER3
AVL Scientific Corp.
33 Mansell Court
Roswell, Georgia 30076
(404) 587-4040
Title SCHEMATIC, MAIN BOARD 9180
Size B
Document Number ZD5015
REV C
Date: May 7, 1996 Sheet 6 of 11

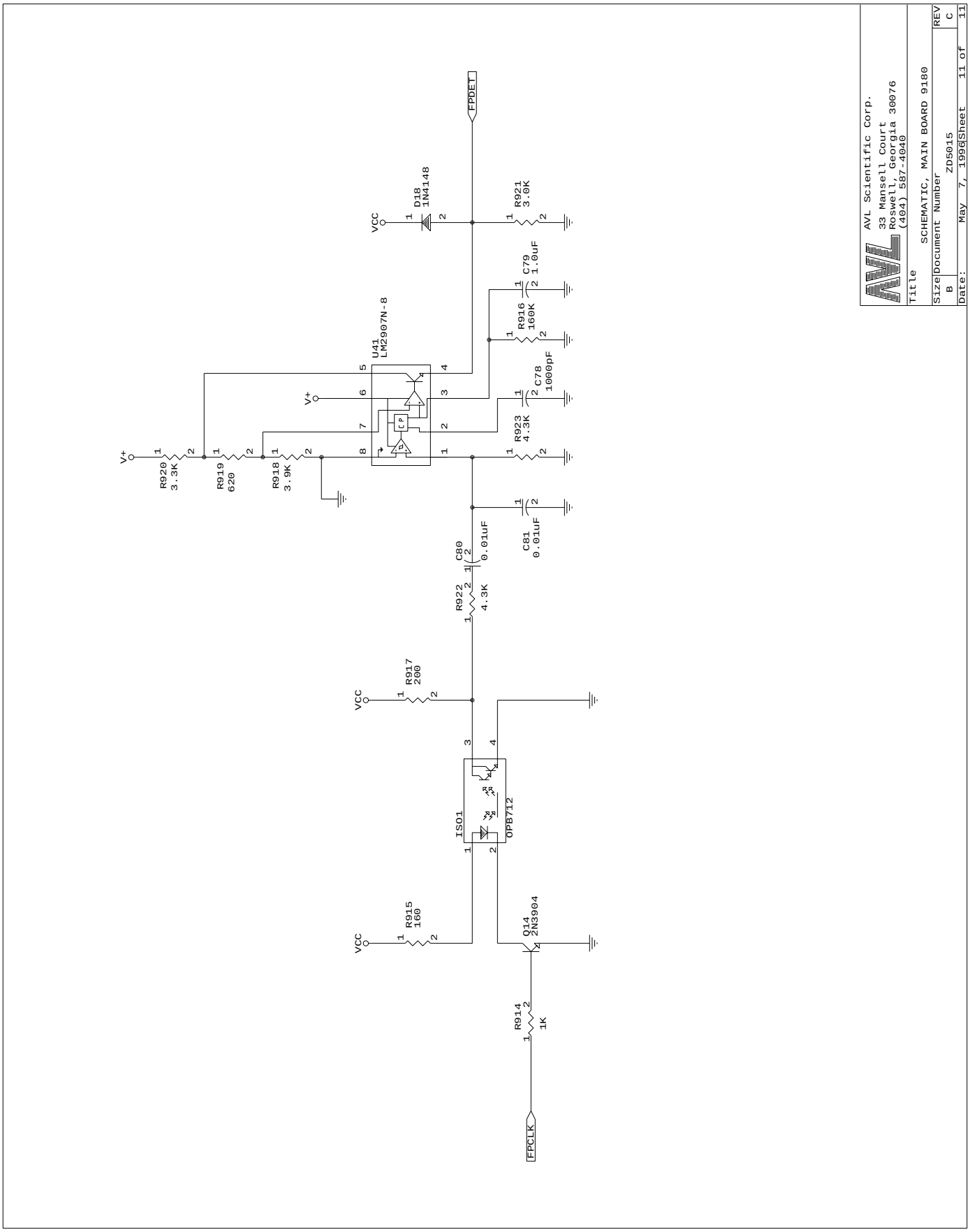
SBC PCB - TEMPERATURE CIRCUIT - 9180, 81

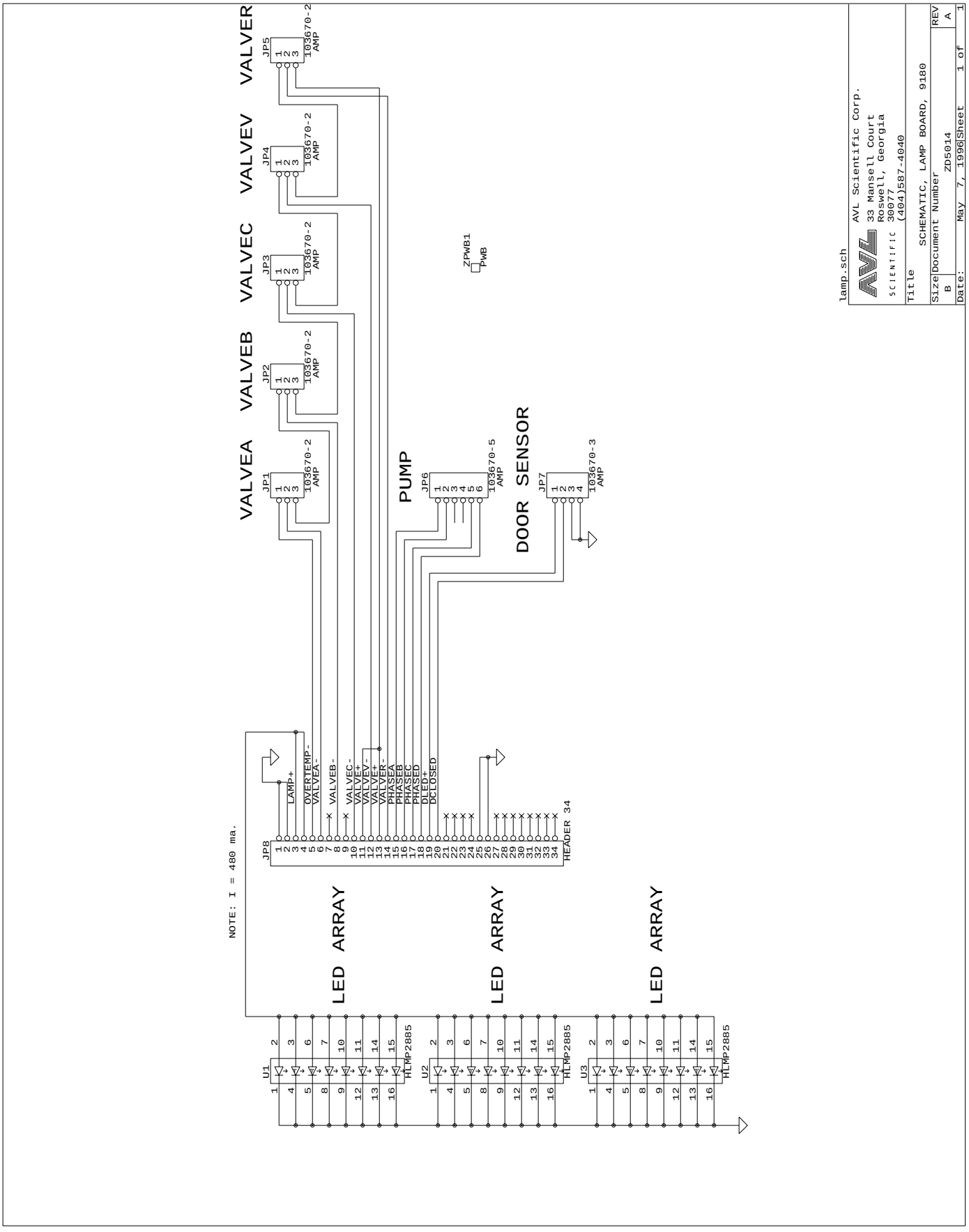



ANALOG CHANNEL SELECTOR
A/D CONVERTER
AVL Scientific Corp.
33 Mansell Court
Roswell, Georgia 30076
(404) 587-4040
Title
SCHEMATIC, MAIN BOARD 9180
Size
B
Document Number
ZD5015
REV
C
Date: May 7, 1996
Sheet 8 of 11
ADDATI0..7I
ADSTATUS
U20
ICL7109
U19
4051
U21
MC1403
X1
3.58MHz
C54
1nF
C55
330nF
C56
150nF
C57
1uF
R61
100K
R71
200K 1%
R72
1K 1%
R73
4.53K 1%
R70
1K
R60
100
R66
1K
R67
1K
R68
1K
R69
1K
TP14
"2.500V"
2.05V
+2.500V
+5VA
-5VA
VCC
-5VA
NOTE:
1 LSB APPROXIMATELY 1mV
NaOUT
KOUT
C1/Ca/LiOUT
TEMPOUT
ADSEL0
ADSEL1
ADSEL2
ADLBEN-
ADHBEN-
ADCE-
ADRUN
DGND
GND


CPU
RAM
PROGRAM EPROM
NON-VOLATILE RAM
BDM CONN
OPTIONAL
AVL Scientific Corp.
33 Mansell Court
Roswell, Georgia 30076
(404) 587-4040
Title SCHEMATIC, MAIN BOARD 9180
Size B
Document Number ZD5015
REV C
Date: May 7, 1996 Sheet 9 of 11
MC68HC16Z1
27C040
6264
MK48T08
U29B 1488
U29A 1488
U29C 1488
U29D 1488
U30C 1489
U30A 1489
U30B 1489
HEADER2X5
DIP32
DIP28
1N4148
32.768KHz
10uH
330K
10M
22pF
0.1uF
1UF 20V
10K
1K
4.7K
VCC
GND
DGND
BERR
RESET-
LAMPEN
PUMPEN
FAST/SLOW-
VALVE-
PUMPSTEP
UPNDPOS
LWNDPOS
UPTBPOS
LWTBPOS
TABLEPRES
CW/CCW
NDWOTEN-
TBWOTEN-
ROTCLK
RTS
RS232OUT
RS232IN
CTS
CTSIN
TACHO
FPDET
DOOR
SAMPLE
THERM-
ADSTATUS
DISPBF
CHECK
FEED
YES-
NO-
BUZZER
FPCLK
LOSEL3
LOSEL2
LOSEL1
LOSEL0
SCK
MISO
MOSI
ADOSTR
VASTR
PRSTR
DISTR
ADISTR
+5VA
V+
A[0..18]
D[8..15]


ADCTRL
VACTRL
PRCTRL
DSPDATA
ADDATA
AVL Scientific Corp.
33 Mansell Court
Roswell, Georgia 30076
(404) 587-4040
SCHEMATIC, MAIN BOARD 9180
ZD5015
Date: May 7, 1996 Sheet 10 of 11
74HC594
74HC595
74HC165
LB1256
LF353
2N3904
2N3906
PKM22EPP-4001
5KPOT
"SS ADJ."
MOSI
SCK
SSEN
ADSTR
RESET-
VASTR
PRSTR
DTSTR
ADDAT[0..7]
ADTSTR
SAMPLE
DGND
GND
ADRUN
ADCE-
DISPBF
MISO
CONTRAST
SAMPLELED-
BUZZER
PRINTVCC
PGND
+5VA
-5VA
VCC
V+


AVL Scientific Corp.
33 Mansell Court
Roswell, Georgia 30076
(404) 587-4040
Title
SCHEMATIC, MAIN BOARD 9180
Size
B
Document Number
ZD5015
REV
C
Date: May 7, 1996
Sheet 11 of 11
FPDET
D18
1N4148
VCC
R921
3.0K
C79
1.0uF
R916
160K
U41
LM2907N-8
C78
1000pF
V+
R923
4.3K
R920
3.3K
R919
620
R918
3.9K
C80
0.01uF
C81
0.01uF
R922
4.3K
R917
200
IS01
OPB712
R915
160
Q14
2N3904
R914
1K
FPCLK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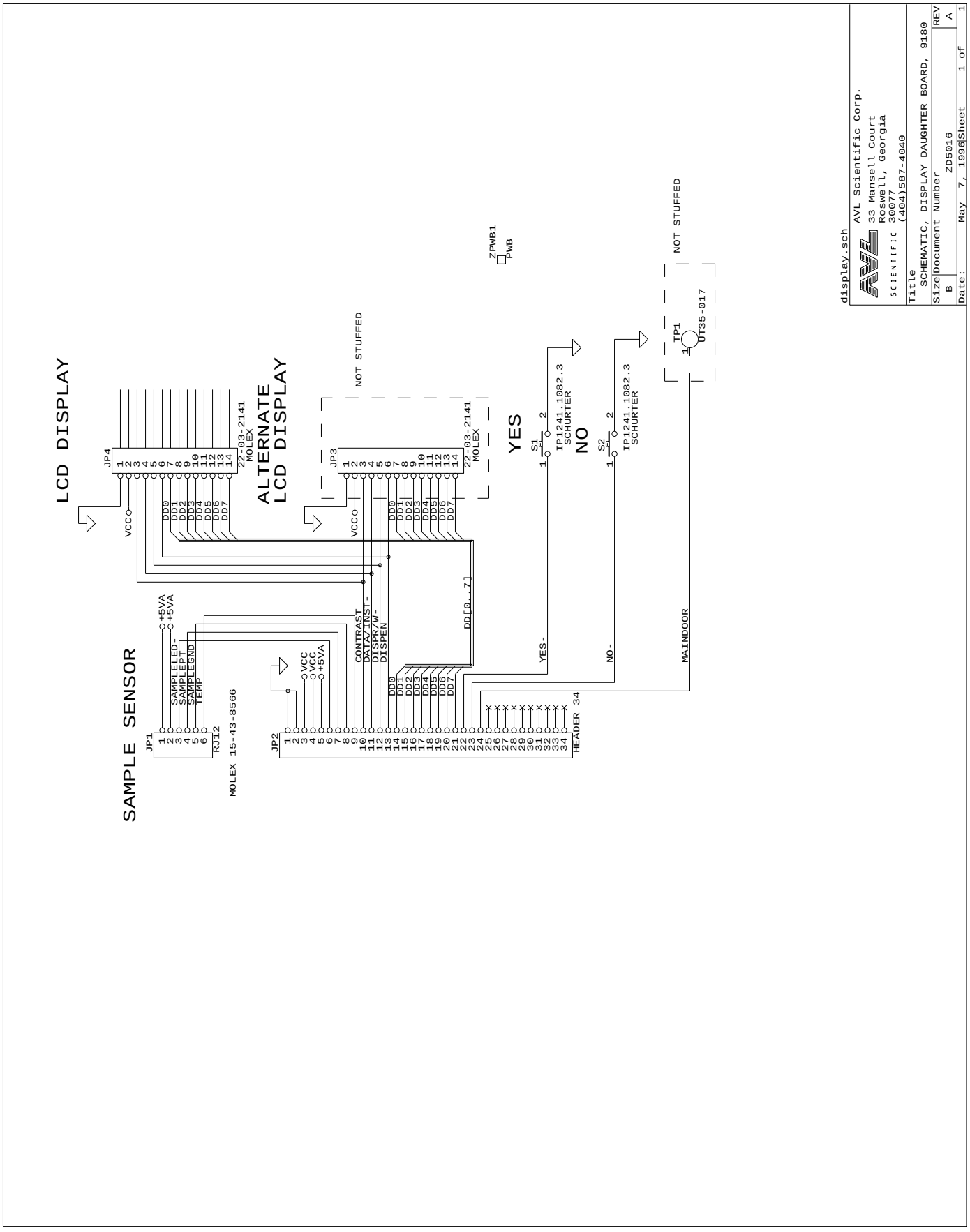
VALVEB
VALVEC
VALVEV
VALVER
PUMP
DOOR SENSOR
LED ARRAY
LED ARRAY
LED ARRAY
JP1
JP2
JP3
JP4
JP5
JP6
JP7
JP8
103670-2 AMP
103670-5 AMP
103670-3 AMP
ZPWB1
PWB
U1
U2
U3
HLMP2885
HEADER 34
LAMP+
OVERTEMP-
VALVEA-
VALVEB-
VALVEC-
VALVE+
VALVEV-
VALVE+
VALVER-
PHASEA
PHASEB
PHASEC
PHASED
DLED+
DCLOSED
NOTE: I = 480 ma.
lamp.sch
AVL Scientific Corp.
33 Mansell Court
Roswell, Georgia
SCIENTIFIC 30077
(404)587-4040
Title SCHEMATIC, LAMP BOARD, 9180
Size B
Document Number ZD5014
REV A
Date: May 7, 1996 Sheet 1 of 1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ALTERNATE LCD DISPLAY
NOT STUFFED
SAMPLE SENSOR
YES
NO
NOT STUFFED
ZPWB1
PWB
JP1
JP2
JP3
JP4
S1
S2
TP1
RJ12
MOLEX 15-43-8566
22-03-2141 MOLEX
IP1241.1082.3 SCHURTER
UT35-017
HEADER 34
VCC
+5VA
SAMPLELED-
SAMPLEPT-
SAMPLEGND
TEMP
CONTRAST
CONTRAST-
DISPR/W-
DISPEN
DD0
DD1
DD2
DD3
DD4
DD5
DD6
DD7
DD[0..7]
YES-
NO-
MAINDOOR
display.sch
AVL Scientific Corp.
33 Mansell Court
Roswell, Georgia
30077
(404)587-4040
Title
SCHEMATIC, DISPLAY DAUGHTER BOARD, 9180
Size Document Number REV
B ZD5016 A
Date: May 7, 1996 Sheet 1 of 1

8 Parts List

MAIN ASSEMBLY FRONT

Item	Part	Description
1	YB5005	SLEEVE: BLACK ELECTRODE HOLDER
2	BP5008	DOOR: ISE FRONT COMPLETE (OLD COLOR)
2	BP5084	DOOR: ISE FRONT COMPLETE (NEW COLOR)
3	BP5005	NEEDLE UNIT: COMPLETE MECHANISM
4	RE5018	TRAY: ISE ELECTRODE
5	BP5009	MODULE: ELECTRODE HOLDER - 9120, 30
5	BP5188	MODULE: ELECTRODE HOLDER - 9180
5	BP5035	MODULE: ELECTRODE HOLDER - 9140
6	BP5004	MODULE: ISE PRINTER
7	RE5016	TRAY: ISE PRINTER PAPER
8	BP5012	TUBE SET: ISE COMPLETE - 9120, 30, 40
8	BP5193	TUBE SET: ISE COMPLETE - 9180
9	BP5027	TUBE SET: PERISTALTIC PUMP
10	BP0087	CLAMP: PRESSURE PIECE VALVE TUBING
11	YA0296	CAP: SOLENOID VALVE LOCK
12	ZB5012	LABEL: 91XX PAPER INSERTION DIAGRAM
12	ZB5129	LABEL: 9180 PAPER INSERTION DIAGRAM
13	ZB5007	LABEL: 9120 ELECTRODE HOLDER
13	ZB5009	LABEL: 9130 ELECTRODE HOLDER
13	ZB5027	LABEL: 9140 ELECTRODE HOLDER
13	ZB5124	LABEL: 9180 ELECTRODE HOLDER
14	DS5004	SCREW: ALLEN HEAD 8-32 X .625
15	DZ5002	WASHER: #8 STAINLESS FLAT
16	ZB5001	LABEL: SAMPLE SENSOR CABLE
17	ZB5015	LABEL: ELECTRODE LIGHT WINDOW
18	ZB5005	LABEL: AVL 9120 OVERLAY
18	ZB5006	LABEL: AVL 9130 OVERLAY
18	ZB5025	LABEL: AVL 9140 OVERLAY
18	ZB5123	LABEL: AVL 9180 OVERLAY
19	ZB5024	LABEL: PAPER TEAR BAR

MAIN ASSEMBLY REAR

Item	Part	Description
1	BP5013	PANEL: ISE BACK COMPLETE (OLD COLOR)
1	BP5083	PANEL: ISE BACK COMPLETE (NEW COLOR)
2	BB5005	PC CARD: ISE SBC COMPLETE 9120/9130
2	BB5006	PC CARD: ISE SBC COMPLETE 9140
2	BB5015	PC CARD: ISE SBC COMPLETE 9180
3	US3059	PROGRAM SET: 9120 ENGLISH
3	US3060	PROGRAM SET: 9130 ENGLISH
3	US3061	PROGRAM SET: 9140 ENGLISH
3	US5010	PROGRAM SET: 9180
4	BB5007	PC CARD: ISE LAMP - 9120, 30, 40
4	BB5014	PC CARD: ISE LAMP - 9180
5	BP5007	SOLENOID: COMPLETE ISE
6	BP5002	MOTOR: ISE PERISTALTIC PUMP
7	BB5002	PC CARD: ISE DISPLAY COMPLETE - 9120, 30 , 40
7	BB5016	PC CARD: ISE DISPLAY COMPLETE - 9180
8	RE5025	SPACER: 50 DEGREE
9	DS5005	SCREW: #6 X .625"
10	DZ0488	WASHER: LOCK M4
11	EU1019	CONNECTOR: GROUND LUG
12	DS5006	SCREW: #6 X .375"
13	BP5003	PUMP ROLLER: ISE PERISTALTIC PUMP
14	DS5001	SCREW: 6-32 X .312"
15	DS5006	SCREW: #6 X .375"
16	DZ5000	WASHER: FLAT
17	DS5006	SCREW: #6 X .375"
18	DS0970	SCREW: PUMP MOTOR MOUNTING
19	DS5002	SCREW: SOLENOID VALVE MOUNTING
20	YB5002	SPRING PROBE: ELECTRODE CONNECTOR

ELECTRODE HOLDER ASSEMBLY

Item	Part	Description
0	BP5009	MODULE: ELECTRODE HOLDER COMPLETE ASSEMBLY 9120/9130
0	BP5035	MODULE: ELECTRODE HOLDER COMPLETE ASSEMBLY 9140
0	BP5188	MODULE: ELECTRODE HOLDER COMPLETE ASSEMBLY 9180
1	BP0171	ELECTRODE HOLDER: LEFT SIDE ASSEMBLY
2	BP5010	HOLDER: ISE RIGHT ELECTRODE 9120/9130
2	BP5036	HOLDER: ISE RIGHT ELECTRODE 9140/80
3	RE5019	HOLDER: BASE ISE ELECTRODE
4	DS0970	SCREW: PHILLIPS M4x16
5	DA0156	O-RING: ELECTRODE SEAL
6	ZB5007	LABEL: 9120 ELECTRODE HOLDER
6	ZB5009	LABEL: 9130 ELECTRODE HOLDER
6	ZB5027	LABEL: 9140 ELECTRODE HOLDER
6	ZB5124	LABEL: 9180 ELECTRODE HOLDER

NEEDLE UNIT ASSEMBLY

Item	Part	Description
0	BP5005	NEEDLE UNIT: COMPLETE MECHANISM
1	RE5011	PLATE: ISE NEEDLE UNIT RIGHT MOUNTING
2	RE5010	PLATE: ISE NEEDLE UNIT LEFT MOUNTING
3	RE5012	HOLDER: ISE NEEDLE UNIT PROBE
4	RE5014	GEAR: ISE NEEDLE UNIT
5	BP5018	LIGHT GATE: ISE NEEDLE UNIT COMPLETE
6	RE5029	PLUNGER: ISE NEEDLE UNIT
7	YB5001	SPRING: ISE NEEDLE UNIT
8	RE5028	ROD: ISE NEEDLE UNIT
9	RE5009	FLAP: ISE NEEDLE UNIT
10	BP5006	PROBE: ISE COMPLETE
11	BP9043	FILLPORT: ASSEMBLY
12	YA9023	PLATE: FILL PORT MOUNTING
13	DS5006	SCREW: #6 X 0.375"
14	DS5000	SCREW: #6 X .312
15	DZ0478	WASHER: FLAT M3
16	SS5003	TUBING: 3/8"OD X 1/4"ID CLEAR SILICON
17	YB5006	RUBBER STOP: ISE NEEDLE UNIT

REAR PANEL ASSEMBLY

Item	Part	Description
0	BP5013	PANEL: ISE BACK COMPLETE (OLD COLOR)
0	BP5083	PANEL: ISE BACK COMPLETE (NEW COLOR)
1	BP5030	COVER: PAINTED ISE REAR (OLD COLOR)
1	BP5081	COVER: PAINTED ISE REAR (NEW COLOR)
2	BN5000	MODULE: SWITCHING ISE POWER SUPPLY
3	BK5000	RECEPTACLE: AC POWER WITH CABLE
4	EU5004	HOLDER: 2 POLE ISE FUSE
5	EV0044	FUSE: 1.6A SLOW
6	NS0025	SCREW PLASTIC TAPING
7	DS5000	SCREW: #6 X .312
8	EU1019	CONNECTOR: FASTON 6.3
9	BK5001	CABLE: DC ASSEMBLY
10	BK5012	CABLE: GROUND ASSEMBLY

FRONT DOOR ASSEMBLY

Item	Part	Description
0	BP5008	DOOR: ISE FRONT COMPLETE (OLD COLOR)
0	BP5084	DOOR: ISE FRONT COMPLETE (NEW COLOR)
1	RE5008	WINDOW: ISE FRONT DOOR
2	ZB5002	LABEL: 91XX ISE TUBING DIAGRAM
2	ZB5125	LABEL: 9180 ISE TUBING DIAGRAM

9 Interface Specifications

9.1 Interface Information

The AVL 9120, 30, 40, 80 and 81 analyzers are equipped with a standard serial interface output. This interface output is intended to be used with standard commercially available computer systems.

The data transmitted through the serial interface port employs the ASCII code.

The serial interface is terminated on the rear cover with a 9-pin male DB-9 connector.

The signal levels are as follows:

- Binary 1 = -12V to -3V
- Binary 0 = +3V to +12V

Two stop bits follow the eight data bits to complete the 10 bit word.

The baud rate is set at 9600 Baud fixed.

The maximal recommended cable length is 40 feet.

The pin assignment is as follows:

pin 1...sample ground...GND
pin 2...receive data....RxD
pin 3...send data.....TxD
pin 4...NC
pin 5...signal ground...GND
pin 6...NC
pin 7...RTS
pin 8...CTS
pin 9...NC

(NC=Not Connected)

Software

The patient sample data is sent at the end of each measurement, the calibration report is sent at the end of each calibration.

The interface is always on, independent of the printer settings; the data is always sent.

Note: The arrow up (e.g. out of normal range) is sent as HEX 18 (↑), the arrow down as HEX19 (↓) and the ° (degree) is sent as HEX1A (→).

9.2 Example Data String Information

Automatic Calibration Report

sx* AVL 9130 *crcrlfELECTROLYTE ISEcrcrlf03JAN92 10:51crcrlf*CALIBR REPORT*crcrlfcrcrlfDailyMaintenancecrcrlf Performed Last: crcrlf02JAN92 10:35crcrlfcrcrlf Standard AcrcrlfNa = -112mV (3)crcrlfK = -1392mV (3) crcrlfCl = -106mV (3)crcrlfcrcrlfDifference A-Bcrcrlf Na = 1402mV ( )cr crlfK = 1032mV ( )crcrlfCl = -1006mV ( ) crcrlfcrcrlfFluid Pack:crcrlf6 8% Remainingcrcrlfcrcrlfex

Serum Sample Report

sx* AVL 9130 *crcrlfELECTROLYTE ISEcrcrlf03JAN92 10:59crcrlfcrcrlf Name: .....crcrlf .....crcrlfSample: SERUMcrcrlfcrcrlf Sample No.13 crcrlfcrcrlfNa= 159soh mmol/LcrcrlfK = 5.4 mmol/LcrcrlfCl= 122soh mmol/Lcrcrlfcrcrlf*PERFORM DAILY *crcrlf*MAINTENANCE ! *crcrlfcrcrlfex

9.3 Data Link Information (9180/9181 only)

The data link with the AVL Compact 2/3 blood gas analyzer allows to combine ISE results with pH/blood gas results on one printout. If Ca^{++} is activated on the 9180/9181, a pH-corrected Ca^{++} value will be calculated and printed on the combined sample report.

For connection of the 9180/9181 analyzer to the Compact 2/3 analyzer, the optional Interface Kit (BP5202) is required. To install the kit, first turn both instruments off. Connect the interface filter provided in the kit to the RS232 port on the 9180/9181. Then connect one end of the cable to the interface filter, the other end to the **COM 2** port on the Compact 2/3. On the Compact 2/3, select **9180** under the COM2 interface options.
See Compact 2/3 Operator's Manual for details.